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This paper provides an exposition of some points of theoretical interest raised in one of Piaget's most recent and as yet untranslated, books Les Mécanismes Perceptifs.* *This involves an interpretation of Piaget's contention that higher order operations are products of the interaction of lower order functions rather than extensions and combinations thereof.*

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Piaget's Recent Formulations on Perception and Intelligence

Twenty years of research on perceptual and conceptual development undertaken by Piaget and his colleagues is synthesized in *Les Mécanismes Perceptifs.* The primary purpose of Piaget's synthesis is to develop a theoretical basis enabling him to determine whether or not the structures of intelligence, such as notions, concepts, and operations, are of perceptual or non-perceptual origin. That is, are the structures of intelligence dependent upon perception to provide all of the elements necessary to their development or are they the products of a cognitively controlled perceptual activity? Piaget states that:

> Between the most elementary perceptual structures and the most complex operational structures of intelligence, we find an uninterrupted series of intermediaries. One of the most remarkable is provided by the representative preoperational intelligence of the child, who is constantly dominated by forms of reasoning bearing, not on transformations as such, but on configurations which are in fact analogous to perceptual configurations (for example, the absence of homogeneity between filled intervals and empty intervals, the non equivalence between a whole not divided and the same totality fragmented into separate parts, *etc.*)
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> In spite of the existence of such intermediaries and of such a continuity, we cannot ignore the fact that the purely operational structures of intelligence

*Jean Piaget, *Les Mécanismes Perceptifs.* (Paris: Presses Universitaires de France, 1961). All quotations hereafter are from this book and have been translated by the author of this article.

> and the initial perceptual structures differ qualitatively. Of course, both constitute forms of equilibrium and both consist of structures of 'ensembles' characterized by their laws of totality. But, to the non-additive and non-reversible nature of the perceptual structures succeeds the rigourously additive and reversible nature of the operations, and it is thus impossible to reduce the superior structure to a combination of inferior structures in accordance with a single type of structuration process such as the clear but restrictive formulation of Gestalt psychology. (P. 13.)

Whereas the Gestalt school claims that the characteristics of a totality can be determined by an examination of its parts; Piaget insists that the whole can be derived only by studying the interrelation of its parts. These opposing points of view are stated by Piaget as follows:

> The genetic interpretation which seems at first glance to be the most reasonable, in light of the known data, is that of a direct linear continuity between perception and intelligence, with the perceptual structures progressively broadening and increasing in flexibility until they engender the operational structures. . . . On the other hand, according to a second interpretation, it would be appropriate to distinguish at every level of the development of cognitive functions, an operative* aspect (from motor activity, to intellectual operations) and a figurative aspect (perception, image, etc.): whereas the operative structures would engender themselves through a continuous filiation, from sensory motor activities to operational intelligence, the figurative structures, on the contrary, would constantly be subordinated to them and would not develop themselves through a direct filiation from one to the other, but through progressive increments beginning with the operative structures and their interaction with experimental data (p. 353).

This thesis is developed in Chapters VI to VIII of *Les Mécanismes Perceptifs;* which Piaget describes as an elaboration and in part a notably new formulation of his theory. The purpose of this paper is to draw attention to Piaget's conclusions on the relation between perception and intelligence derived from a search for similarities, differences and possible connections between those structures. Before undertaking the exposition of these points it would be advisable to specify what Piaget means when he uses the terms perception and intelligence.

Perception for Piaget involves those structures which give the most direct and immediate knowledge of an object in the sensorial field. That is, structures which involve more than the simplest consideration of a stimulus are held to involve intellectual rather than perceptual acts.

Intelligence is held to be ". . . nothing more than the system of 'ensembles' of cognitive functions . . .", (p. 13). A remarkably "Gestaltish" formulation which rids Piaget of the difficulties which would arise were he to postulate the existence of a faculty of intelligence distinct from other cognitive functions.

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*We shall distinguish in what follows the terms operation (=relative to operations properly so called) and operative (=relative to the actions of every level and to the operations). (Footnote in original.)

Piaget (pp. 353-385), systematically compares the structures of perception and intelligence first by inquiring into the differences between them and then by developing their similarities. That method shall be followed in this paper which, it should be stressed, is only the author's interpretation of Piaget's position and not claimed to be an original formulation.

There appear to be many fundamental differences separating the structures of intelligence and perception. Piaget claims that "These differences can be grouped under two headings: (I) those arising from the relations between the subject and the object; and (II) those which are relative to the structures or to the forms as such." (P. 355.)

I. Subject-Object Relations

(1) Perception requires the physical presence of the object in order to act upon it. Whereas intelligence can evoke thoughts of the object in its physical absence by symbolic reference to it; and even when the object is physically present intelligence interprets the object with reference to a conceptual framework.

(2) Perception is limited by proximity in time and space whereas intelligence is not so restricted.

(3) Perception is essentially egocentric, personal and incommunicable since it is bound to the relation existing between subject and object at any given time. On the other hand the structures of intelligence attempt to arrive at a universal, communicable, knowledge independent of the self.

(4) From (1) and (3) a more general difference may be drawn; namely, that whereas perception is restricted to phenomenalistic sense data intelligence is not.

(5) Perception is limited in its expression since in its terms of reference signifier and signified are bound one to the other and are largely undifferentiated and interchangeable. Whereas intelligence in its use of symbol and sign differentiates between signifier and signified and develops the possibility of communication.

(6) Perception cannot retain separate elements or characteristics of an object through abstraction: Intelligence can abstract from the available data those elements required to arrive at a problem solution.

II. Structural Differences

(7) Primary perceptions are rigid in their structure whereas operational structures are flexible in the sense that the subject can at will construct and destroy them internally, and generalize them externally.

(8) In the perceptual domain the form is indissociable from its con-

tent while in the operational domain it is possible to manipulate the form independently of its content.

(9) Perceptual compositions as compared to operational compositions are incomplete and poorly delimited through lack of abstraction.

(10) While a perceptual "good form" can only attain *pragnanz* an operational "good form" imposes itself with *necessity*.

(11) The perceptual schema is only a temporal one with successive assimilations and without the possibility of eventual union into a simultaneous whole which clearly characterizes classes. It is not possible to perceive classes (as opposed to collections) but classes can be developed through intellectual operations.

(12) Perception modifies the elements it connects and through this process distorts them. Operational relations, on the other hand, conserve the unique aspects of those elements which they connect.

(13) Perception permits certain inferential procedures but they are immediate in nature and non-controllable by the subject in the course of their development; whereas by inferences which are unique to intelligence, the subject can distinguish and control the data assimilated and conclusions reached therefrom.

(14) Perception as compared to intelligence is non-reversible. That is, transformations involving inversion, reciprocity, addition, and subtraction can only be understood by the reversible structures of intelligence.

In the preceding pages the differences between primary perception and intelligence appear greater than they actually are; for in comparing the extremes of each function it has been necessary to ignore modifying intermediaries such as field effects, multiple perceptual activities, and various developmental levels. However, Piaget states that ". . . since operational intelligence is itself constituted of distinct developmental levels and is preceded genetically by sensory-motor intelligence and the preoperational forms of representative intelligence; it goes without saying that between the extremes which have been contrasted there must be a bridge of intermediaries." (P. 365.)

In what follows Piaget attempts to uncover gradations in those elements common to the extreme terms of perception and intelligence; and to establish whether progression along those gradations is a result of the intervention of properties which are not reducible to simple combinations of subordinate functions.

This is effected by describing the similarities and intermediaries existing between those aspects of perception and intelligence whose basic differences have been listed in the foregoing passages. Points raised

in this section are numbered so as to correspond to those raised in the preceding section.

(1) Clearly, knowledge of an object always requires elaboration, and this reorganization of the object's properties is quicker in its presence. The differences then between immediate and mediating and even between presence and absence of the object are merely differences of degree. Since the immediately perceived object is not present in its totality for the subject; it can only become so by a series of incomplete and heterogeneous encounters. The very coupling of these encounters is itself a mediating process; which indicates that the superior level activity although dependent upon the inferior level activity for its initiation, nonetheless modifies it as a function of their interaction.

(2) Perceptual fields require at all levels the intervention (between simultaneously perceived elements), of certain distances (space) however short they may be (time). Primary perception is absolutely bound by space and time, but this extreme is manifested only in the tachistoscopic presentation of a small object. The perceptual activity attendant upon a presentation permitting encounters and couplings leads to the liberation from proximity, which is really only a special case of distance. However, this liberation is a drawn out process; a fact clearly seen in the subordination of preoperational representations to spatial configurations.

(3) Nowhere is the gradual passage from an inferior to a superior level more clearly seen or more adequately elaborated than in the developing child's departure from egocentric modes of perceiving and thinking. Perceptual centrations and intellectual decentrations interact to free the child from egocentricity. However, it is clear that the superior modes of decentration are not simple extensions of particular perceptual decentrations, such as might be observed in the perception of a figure. On the contrary, it is perceptual activity which engenders perceptual decentrations, which give rise to the superior modes of decentration. Once formed, however, the superior modes of decentration direct perceptual decentrations.

(4) There are many intermediaries between the phenomenalism of primary perceptions and the rational constructions of operational structures. For example, in the domain of perceptual activities the most striking are the constancies of size, which entail the substitution of real size for apparent size. However, concrete operation level conservation notwithstanding only formal operations signal the final victory of deduction over appearance.

(5) The differences between perceptual indices and symbols and signs appear to be irreconcilable. However, the gradual intervention of sensory-motor indices, such as signs or signals to which responses become con-

ditional and which are dependent upon poorly internalized mental images which dissociate themselves gradually from the context of sensory-motor adaptation, ensure the transition of symbolization from the sensory-motor level to the representational level through the process of imitation.

(6) With regard to the process of abstraction it is possible to discern, at a superior level of perceptual activity, certain plans of analytical exploration which represent an elementary form of abstraction. But in such cases, the effort of dissociation is directed by intentions arising from a supra-perceptual level such as conceptual plans.

(7) Although primary perceptions are themselves rigid it is only through their recurrence and the recurrence of the perceptual activity engendered by them that operational flexibility can slowly evolve. The numerous preoperational phases; wherein the child's thought remains in many ways attached to relatively rigid configurations similar to those of perception, give evidence of the slow growth of the operational flexibility of intelligence.

(8) With regard to the relations between form and content perception and intelligence both use a common fundamental mechanism in that both must deal with forms whether they are or are not indissociable from their content. The development of all cognitive mechanisms entails a painfully slow liberation from the restrictions imposed by forms. Perceptual activities such as transfer, transpositions, and anticipations herald and direct the onset of dissociation. But this rudimentary dissociation is only a building block for the dissociative structures of formal operations, which will, as they grow, facilitate and direct perceptual activity in order to increase the range and flexibility of the dissociative structure.

(9) If the foregoing holds, it is obvious that the incompleteness and poor delimitation of perceptual compositions as opposed to operational compositions is due to the fact that the former are only parts of the latter which is the whole. Here again, it is worth noting that the superior level compositions cannot result from a mere addition of various inferior level compositions.

(10) There is a relative continuity of intermediaries between perceptual *pragnanz* and logical *necessity*. Consider the response of the child at the concrete operations level who uses the term *"c'est forcé"* to characterize a transitive composition. The continuity between *pragnanz* and *necessity*, however, does not imply that the latter is a simple combination of the elements of the former. Necessity is, psychologically speaking, only the expression of the regulated compositions of an operational structure complete in itself, and thus not allowing for or requiring a decision.

(11) With regard to the difference between perceptual schemas and

logical classes as well as between perceptual pre-infraclasses and operational infraclasses such as classes of continuous elements, it can be seen that a series of intermediaries intervene between sensory-motor schemas and the diverse structures of the logic of classes. While the superior level structures cannot be derived from their perceptual correspondents, it is possible to show how the development of the former beginning with sensory motor actions, is likely to broaden the perceptual activities, and from there through sedimentation affect field effects. That logical classes are not derived from the schemas and collective forms of perception is a result of the fact that logical classes are bound up with a system of transformations and operations.

(12) Between the distortion due to perceptual relations and the conservation produced by logical relations exist operational systems such as seriation which are derived from perceptual activity and not primary perception. It is perceptual activity and not perception which allows the subject to consider the object without distorting it.

(13) With regard to inferences in general, it is easy enough to distinguish a series of intermediate levels between the most elementary perceptual pre-inferences and the logically regulated operational inferences; but it is no less clear that the passage from one level to the following is not merely a function of the extension of the preceding level's structures. Rather this progression is due to the construction of new schemas which permit the inferences proper to the succeeding level.

(14) Operational reversibility requires inverse and reciprocal operations which of necessity deal with, classes, relations, numbers and propositions—realities which are irreducible to purely perceptual forms. The previous points have indicated that superior level structures influence the orientation of inferior level structure but they are not in fact uniquely derived from them. In the case of reversibility it is clear that intelligence controls and guides perception in the direction of reversibility but that perception itself is non-reversible.

On the basis of the foregoing argument and of additional considerations developed in Chapter VII, Piaget concludes that ". . . intelligence is not derived from perception by simple extensions or an increase in flexibility, because the operational factor relative to transformational systems remains irreducible to figural structures, even if these arise from activities, properly so called, but which are oriented toward representation in a manner similar to that of perceptual activities." (P. 439.)

In conclusion it should be noted that this paper barely introduces the complexity of Piaget's theory. Therefore, the brief statements advanced herein should be considered as a sampler—not an authoritative translation of Piaget's position.

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A case is presented for the acceptance of the clinical approach to questioning as a legitimate tool of scientific inquiry. Theoretical justification and empirical evidence are presented to demonstrate its superiority over the standardized approach when assessing the intellectual development of children.

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A Note on Piaget's Clinical Method of Questioning

Many American Psychologists have been critical of the clinical method of questioning as a legitimate scientific tool for assessing not only the intellectual development of the children, but any developmental aspect of the child. They believe it violates scientific methodology, primarily because of its reliance on the use of varying questions from the child to the child. Were most of these psychologists to see the clinical method performed by the Geneva school, they would further argue that the pace of the experimenter varies with each child which also violates scientific method.

The stubborn refusal to accept this approach or rather incorporate this approach as a legitimate aspect of scientific method manifests a kind of ego-centrism, which refuses to acknowledge as scientific, a method other than a particular standardized approach. This methodological rigidity may be likened to the early mathematicians who, because of their fixation on the physicalistic notion of numbers, refused to admit that negative integers and irrationals were also numbers. However, once these mathematicians acknowledged an alternative approach to viewing number, they extended their conception of number to incorporate non-physicalistic entities. Consequently, their problems with conceptualizing negative numbers and irrationals evaporated.

Similarly, the purpose here is to confront those hard core psychologists with an alternative method of studying intellectual development,

in contrast to the standardized questioning approach, and present a case for its acceptance as a tool of scientific inquiry. Accordingly, the hope is that the scientific method of inquiry will be extended to incorporate the clinical approach to questioning.

Before proceeding to attempt to demonstrate both the theoretical and empirical justification of such an assessment approach, perhaps an examination of the origins of the standardized approach will point to some of the weaknesses which necessitated the development of an alternative assessment approach in intellectual development.

The standardized questioning approach, which puts a premium on both the uniformity of the experimental situation and the mode of questioning has its origin in behaviourism. Koch,[1] makes a strong case that behaviourism focuses primarily on a *method* of studying human learning, rather than a substantive area of learning. He maintains that behaviourists have become so obsessed with their methodology that it has prevented them from studying many fruitful areas of learning. Because of such a paucity of fruitful areas which such a methodology fosters, behaviourists have taken concepts from areas such as gestalt psychology and developmental psychology. In particular, Koch maintains that the usual behaviourist concern with perception and central processes could be traced to forementioned schools. More recently neobehaviourists such as Berlyne[2] have attempted to incorporate Piagetian notions into their systems. Koch aptly describes this position when he states that the behavioural position was adopted "more to serve the needs for comfort and security than a passion for knowledge". Koch argues that the philosophical base on which such a methodology exists has for the most part evaporated. In the past decade scientific method has undergone a significant redefinition to which behaviourists have frequently closed their eyes. For example, the observation base has been expanded to include introspection as a legitimate kind of observation, which however many behaviourists still reject. Thus, it is apparent that not only has the standardized approach its origins in behaviourism, but that such a methodology constitutes the essential ingredients of behaviourism.

This evidence does not mean that the standardized questioning approach has little or no utility. What is argued is that its *scope* is necessarily limited. Clearly for certain situations the standardized approach has distinct advantages whereas for other situations, as will be shown, the standardized approach has severe limitations. In much the same manner Newtonian mechanics, in spite of its limitations, was not replaced by relativity theory, but rather for certain situations it seemed more appropriate to employ than relativity theory.

Having demonstrated from a historical point of view that the standard questioning approach, with its origins in behaviourism, derives

from a limited definition of science, it remains to demonstrate that the clinical method not only derives from a redefinition of science but that both theoretical and empirical evidence exist to demonstrate its superiority over the standardized approach when assessing the intellectual development of children.

Mermelstein and Shulman[3] have demonstrated theoretically that the linguistic quality of the two approaches are identical. Briefly, this entails viewing the varying questions employed in the clinical method as rephrased questions: that is, questions whose event are the same, but whose relationships to the event may be different (an event is the gist of the question). Because of the ego-centric nature of the child he is unable to perceive the relationships to event, but perceives only the event. Consequently these questions are perceived as identical by the child. Further, it is argued that the more frequently the event is presented, the more likely is the guarantee of an accurate assessment in the child. The clinical approach acts as a safety valve because the possible ambiguous questions (questions emphasizing more than one event) are minimized. Such a safety precaution is non-existent in the standardized approach.

Whereas the varying questioning in the clinical approach serve as a safety valve on the cognitive domain, the varying pace serves as a safety valve in the affective domain. Although the pace utilized is suggested by the experimenter's intuition of the child, it is not to be decried as unscientific because it creates favourable environment for questioning. Different children feel more comfortable with different affective environments. Obviously, a case could be made for "pacing" in terms of congruence between the experimenter and the subject. In particular, congruence between experimenter and subjects creates an optimal assessment situation. It follows that such an optimal situation of necessity varies with each child. Consequently the clinical questioning technique is couched in a variable environment which allows for maximum examination of the child's existing structures. Thus by achieving the proper pose the experimenter metaphorically speaking, is able to penetrate the child and tap his cognitive structures much like the doctor who achieves this pose physically when he examines the bone structure of the child. The varying pace, both on the linguistic plane and the affective plane, rests on a redefinition of inquiry, as advocated by Koch[4], who maintains that the organism and not only the environment are a legimate concern of science.

As the method of approximation was not an adequate approach for describing the irrational numbers so it should now be clear from a theoretical point of view, the standardized approach because of its inflexible affective and cognitive approach does not adequately assess intellectual development. Not only does the theoretical posture suggest

the fruitfulness of the clinical approach but the literature is beginning to amass data which also support such a position. That the manner of questioning played a minor role was first suggested by the great number of replications which confirmed Piaget's findings. More recently, in a direct test of the hypothesis that variations of question influence the stage of development, Mermelstein and Shulman[5] generally found that the manner in which one poses a question has relatively little influence on the child's developmental level. The Pratoomraj and Johnson[6] and Smedslund[7] findings are in agreement with Mermelstein's. Hence, the empirical evidence suggests that rephrasing the question, an important criticism of the clinical method, plays little or no role on the assessment of the child's development.

Personal observation of the clinical approach at Geneva and studies of the tapes of these sessions have convinced me of the merits of the arguments presented above. If the development of mathematics provides a mirror at which Psychology may view itself, and if the redefinition of science is acknowledged, and if the theoretical argument with its empirical support is also acknowledged then it is clear that at the very least the clinical approach to questioning deserves much closer attention as a legitimate tool of science.

REFERENCES

[1] Sigmond Koch, "Psychology and Emerging Conceptions of Knowledge as Unitary; Behaviorism and Phenomenology, Contrasting Bases for Modern Psychology", T. W. Wann, (ed.), Phoenix Edition, University of Chicago, 1965.

[2] Daniel E. Berlyne, "Comments on Relations between Piaget's Theory and S-R Theory, *Monograhps of the Society for Research in Child Development,* Vol. XXVII, No. 2, 1962, pp. 127-135.

[3] Egon Mermelstein and Lee Shulman, "Lack of Formal Schooling and Acquisition of Conservation of Substance", *Child Development,* (in press).

[4] Koch, *loc. cit.*

[5] Mermelstein and Shulman, *loc. cit.*

[6] Sawat Pratoomraj and Ronald C. Johnson, "Kinds of Questions and Types of Conservation Tasks as Related to Children's Conservation Responses", *Child Development,* Vol. *XXXVII,* No. 2, 1966, pp. 343-353.

[7] Jan Smedslund, "Microanalysis of Concrete Reasoning, II. The Effect of number of transformations and non-redundant elements, and of some variations in procedure", *Scandinavian Journal of Psychology,* Vol. VII, 1966, pp. 157-164.

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In this article Professor Mermelstein and associates report the results of a study of the efficacy of four training techniques which their originators claimed effective for inducng the concept of conservation of substance. The results do not support the claim and provide further confirmation of Piaget's view that conservation cannot be taught by specific training.

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Training Techniques for the Concept of Conservation*

Increased emphasis on revision of the mathematics curriculum and the introduction of modern mathematics as early as kindergarten has led to the controversy over the most appropriate time to teach the concept of number. As a result, a renewed interest in Piaget's experiments on the child's conception of number has become evident.

According to Piaget, the concept of number is predicated on the concept of conservation of substance. The attainment of the concept of conservation of substance enables the child to recognize that the "amount" or "number" remains the same in spite of spatial rearrangements. The following paragraph describe an example of Piaget's tasks requiring verbal conservation of continuous quantity.

A child is confronted with two identical containers of liquid. After the child has been convinced that the amount of liquid in both is the same, the contents from one of the containers is poured into three other containers. The child is then questioned as to the equality of the amount of liquid in the three containers and the original container. A child is said to have attained the concept of conservation of substance when he

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recognizes that the amounts are the same and he is able to explain why. On the other hand, if the child responds that the amounts are different, then he is said not to have attained the concept of conservation of substance.

Piaget maintains that specific training or teaching plays little or no role in the acquisition of this concept. He suggests that the child attains the concept of conservation of substance by interaction with his "total" environment. In contrast, Bruner[1], Sigel[2], Beilin[3], and Smedslund[4] suggest that one can teach or induce the concept of conservation of substance in the child.

Because there are theoretical reasons for believing that the concept of conservation of substance is relevent to a child's number development, the question arises whether or not children can be taught the concept of conservation of substance.

Theory

Acquisition of the concept of conservation of substance implies a modification of the child's intellectual structure. According to Piaget this modification occurs as a consequence of *all* the child's activity in contrast to specific short term training.

"All" of the child's activity refers to two kinds of experiences: physical and logical mathematical. Whereas physical experiences refer to knowledge acquired by the child's manipulation of objects (i.e. playing with chips), logical mathematical experiences refer to knowledge acquired as a consequence of manipulation (i.e. awareness that two rows of six chips each have the same number despite rearrangement). Although it is apparent that physical experiences are a necessary condition for the acquisition of concepts and indeed short term exposure may be adequate, logical mathematical experiences require a longer period of time because properties or concepts refer not to objects but rather to relationships to objects. Knowledge acquired as a consequence of manipulation implies an awareness of the spatial relationships between objects. These spatial relationships cannot be acquired or induced in short term training.

Obviously if these relationships are acquired over a period of time the contention that short term training on a few specific tasks would induce conservation is as specious as the contention that specific training on a limited number of tasks from I.Q. tests would improve intelligence. Increased performance on these I.Q. tests as a consequence of training does not necessarily imply increased intelligence. So too, specific training on conservation tasks does not guarantee the acquisition of the concept of conservation.

Although Piagetian theory and specific training are incompatible,

some of the literature reported below suggests that intellectual structures can be modified over a relatively short period of time. The problem of this study, then, is to provide more evidence on the question of whether or not mental structures can be modified over a relatively short period of time.

Related Literature

The literature appears equivocal as to the feasibility of inducing the concept of conservation. Consistent with Piagetian theory, Wohlwill[5] has been unsuccessful in inducing conservation of number. Similarly, Beilin and Franklin[6] have been unsuccessful in inducing conservation of area. Prager[7] using her own class was also unable to induce conservation of substance. These studies seem to suggest that regardless of the kind of conservation that one tries to induce, that in general such training is not successful.

In testing for the presence of conservation, rather than attempting to induce it, Mermelstein and Shulman[8] found no diference in performance on conservation of substance tasks between those children who had formal schooling and those who did not. Similarly, Goodnow's[9] study with Hong Kong children and Price-Williams'[10] study with African bush children indicate no difference in performance on conservation of substance tasks between children who had and those who did not have formal schooling. These studies suggest that even more generalized training such as formal schooling does not necessarily modify intellectual structures.

On the other hand, although Smedslund[11] reports negative results in attempting to induce conservation of weight, in another study in which he introduces the idea of cognitive conflict Smedslund[12] appears to have had some success in inducing the concept of conservation of substance. Similarly, Gruen,[13] Bruner,[14] Wallach and Sprott,[15] Roeper,[16] and Sigel[17] utilizing various training techniques induced various kinds of conservation.

If specific training does make a difference in acquiring the concept of conservation, the present investigators feel that Smedslund's cognitive conflict theory provides the greatest promise for success because of its similarity to Piaget's theory of adaptation. Briefly, cognitive conflict theory involves a set of competing responses in a given situation. This set of competing responses induces a conflict which reorganizes the intellectual structures and insures conservation. Piaget's discussion on strategies to decrease egocentric thought in the child provides a good illustration of the similarity of the cognitive conflict position and the adaptation position.

Furthermore, both the adaptation and the cognitive conflict process-

es employ the disequilibrium-equilibrium model. In each instance, the child moves toward a state of temporary equilibrium from a state of disequilibrium. Thus, similarities in the two processes would suggest that training procedures based on a cognitive conflict position may be in part successful. A translation of Smedslund's theoretical position into practice as well as a translation of Bruner's, Beilin's, and Sigel's theoretical position are described in the procedure section.

These studies constitute a representative sample of the various theoretical positions described in the literature which claim success in training on conservation.

Whereas Smedslund's theoretical position is consistent with Piaget, Sigel, Beilin, and Bruner present arguments for inducing conservation which are either wholly inconsistent or only partially consistent with Piagetian theory.

Siegel's argument is predicated on the assumption that one must base the learning of complex structures on simpler structures. He claims that acquisition of conservation of substance follows the acquisition of simpler structures such as multiple labeling, multiple classification, multiple relations, and reversibility. More specifically, he maintains that training in multiple labeling, multiple classification, multiple relations and reversibility, in that order, should facilitate the acquisition of conservation.

Although Sigel's procedures indeed are necessary conditions for conservation of substance, they are not, however, sufficient conditions. Sigel's training assumes that once the prerequisites for conservation have been met the concept of conservation necessarily has been attained. Sigel assumes further that because the material is presented in a prescribed manner, the child will assimilate the material in the corresponding order. Such a claim is not consistent with Piagetian theory for, if the child constructs his reality, it does not necessarily follow that he will assimilate the material in the same manner presented.

Whereas Sigel's training originated in part from Piagetian theory, Beilin's training procedure appears *to violate* Piagetian theory, *Beilin's* training procedure, verbal rule instruction, provides the child with a statement of a rule to be applied to the problem in each instance of an unsuccessful trial response on a conservation task.

The use of a rule in a training technique appears inconsistent with Piagetian theory. To begin with, the egocentric nature of the child's thought seriously hampers his ability to adopt another point of view. Secondly, the syncretic nature of the child's mental structure with its behavioural manifestations of juxtaposition prevents him from accurately perceiving the rule. Further, Mermelstein and Shulman's research indicated that children under 9 years of age perceive only the gist of

questions or the events of the questions. It follows from this that two sentences which stress "amount", for example, but in very different ways, will be perceived as similar by the child. This casts doubt on the child's ability to understand a "specific" rule.

Similarly, Bruner's contentions on language training also appear to be inconsistent with Piagetian theory. Bruner's training position is predicated on the assumption that focusing on the linguistic aspect of a situation will decrease the strength of the perceptual cues resulting in a mental structure which is a function of the language activated. This differs markedly from Piagetian theory in that Piaget believes that mental structure precedes language development.

To recapitulate, because the concept of conservation derives from Piagetian theory and further because the rationale for the Sigel, the Beilin and the Bruner training are judged to be inconsistent with Piagetian theory it was hypothesized that these training procedures would not be effective. On the other hand because of the greater congruence of Smedslund's position to Piagetian theory it was hypothesized that such training would be more successful than the other three training procedures.

Objectives

Accordingly the objectives of this study were to ascertain whether various training procedures can influence the acquisition of the concept of conservation of substance. In view of these objectives the following hypotheses were forwarded:

1. A significant difference exists in the performance in conservation tasks between children who had *cognitive conflict training* and those who had no training.
2. No significant difference exists in the performance on conservation tasks between children who had *multiple classification* training and those who had no training.
3. No significant difference exists in the performance on conservation tasks between children who had *verbal rule training* and those who had no training.
4. No significant difference exists in the performance on conservation tasks between children who had *language activation training* and those who had no training.

Method

Subjects:

In order to assess the effects of various training procedures on the attainment of the concept of conservation of substance a sample of 120 kindergarten children from the Long Island area was selected for study.

Five year olds were chosen because the writings of Piaget indicate that children of this age generally have not attained the concept of conservation of substance. These primary school children were between 5.0 and 6.2 years of age. The subjects were randomly assigned to four training conditions; cognitive conflict, language activation, multiple classification and verbal rule instruction. This random assignment was made with two restrictions. First, equal numbers of males and females were assigned to each condition. Second, non-white children were excluded from the population. The purpose of these restrictions was to control the possible sex and ethnic effects. Twenty subjects were drawn for each of the four training groups and for the two control groups.

The apparatus for all the training techniques conformed in principle to the requirements of each training procedure. Although the present study may not be regarded as an explicit replication of the Smedslund, Bruner, Sigel or Beilin training techniques, it is felt to be a fair test of the principles which underline these techniques. In other words, while there were some slight variations in procedure to make the experimental tasks comparable, the basic assumptions stated by these investigators were not violated.

Procedure

Description of the Pre-Test and Scoring of Responses:

In order to ascertain the effects of pre-testing one control group was given a pre-test whereas the other control group and the four training groups were not. The possibility of the pre-test serving as an additional training session or differentially affecting the various training techniques necessitated its elimination from the training conditions.

The pre-test task employed the collapsible box and 20 poker chips. As the experimenter set up 10 chips down one side of the top of the box the subject simultaneously set up 10 chips in one-to-one correspondence with those of the experimenter. After the experimenter verbally established that he and the child had equal numbers of chips, one row of chips was collapsed by the experimenter, and hence, perceptually distorted. The subject was then asked whether the chips on the collapsed side were still the same amount as those on the stationary side. If the subject's response was positive and his explanation indicated understanding, that is, he realized the chips merely changed position, he was scored as a conserver. A subject who answered affirmatively without an adequate explanation, or a subject who answered negatively was scored as a non-conserver.

Training Procedures:

The four training conditions, cognitive conflict (Smedslund), multiple classification (Sigel), verbal rule instruction (Beilin), and lan-

guage activation (Bruner), each began with free play and were followed by eight training sessions, two per week, for approximately ten minutes each. The first training session was devoted entirely to introducing the subjects to the red, white and blue poker chips and allowing them to manipulate them in any way they chose. In each of the successive eight training sessions for the first two minutes the subjects were permitted to play with the chips. The remainder of each session was devoted to formal training.

Smedslund: Cognitive Conflict The cognitive conflict training involved the collapsible box and twenty poker chips. Following the free play, where the subjects were allowed to manipulate the chips, the group of subjects received ten chips of one colour and the experimenter received ten chips of the same colour. In the first session, red chips were employed, in the second session blue, and in the third white, with this colour order being maintained throughout the remaining sessions. As the experimenter placed a chip on one side of the top of the box, the subjects simultaneously placed another chip next to it until all twenty chips were in one-to-one correspondence. Following the placement of each pair of chips, the experimenter asked the subjects questions such as "Are there the same amount of chips on both sides of the box? Do the children have the same amount as the teacher? How do you know?" If the subjects did not realize the equality of the two rows of chips, they were encouraged to count the chips. After five sessions of setting up the chips in one-to-one correspondence, the task was altered. In the next three sessions, after the chips were similarly set up in one-to-one correspondence and the sameness of the two rows of chips was established, the experimenter moved the switch hinged on the side of the box and one of the rows of chips fell to the center of the collapsed side. The subjects were asked, "Are there still the same amount of chips on both sides?"

Sigel: Multiple Classification—The multiple classification training also involved twenty poker chips and a collapsible box. Free play with the chips preceded the formal training. The training was divided into four phases:

1. multiple labeling
2. multiple classification
3. multiple relations
4. reversibility

For the first four training sessions, one training session was devoted to each phase while each of the remaining four sessions encompassed all four phases.

In multiple labeling training the experimenter initiated discussion which elicited the naming of the poker chips in a variety of ways;

viz., a poker chip can also be a checker or toy money. This "naming" was clarified for the subjects by the experimenter suggesting that a person could have many names; *viz.*, mother, teacher, woman, wife, and others.

In the multiple classification training the experimenter initiated discussion which elicited from the subjects the common properties of the chips; i.e., all the chips have colour, shape, purpose, texture and size.

In the multiple relations training the experimenter initiated discussion which led the subjects to understand that a chip can be two things at the same time. That is, a chip can have a colour and shape at the same time. The question that was posed is, "Can you think of two things this poker chip can be at the same time?" Since a different coloured poker chip was used at each session, three relationships were established: (1) round and red, (2) round and blue, and (3) round and white.

In the reversibility training the collapsible box and twenty chips were employed. The experimenter and the subjects set up the chips in one-to-one correspondence so that the subjects could see the sameness of the two rows of chips. After the subjects responded positively to the question, "Are there the same amount of chips on both sides?", the experimenter collapsed one side of the box. Again the subjects were asked whether there was the same amount of chips on both sides of the box and why. An informal explanation to establish the equivalence of both sides was then provided by the experimenter.

It should be pointed out that although superficial similarities exist between Smedslund's cognitive conflict training and the reversibility training of Sigel, they differ in that in the Sigal reversibility training the equality of the rows of chips and the subsequent collapse of one row was accomplished in one training session whereas Smedslund's training procedure had four training sessions on the equality of chips prior to collapse of one row of chips. In addition the Sigel technique provided explanations for the equivalence of both rows after the deformation, whereas the Smedslund technique did not.

Beilin: Verbal Rule Instruction—The verbal rule instruction, as well as multiple classification, employed the collapsible box and twenty chips. Following the free play the group of subjects and the experimenter each received five chips of one colour. As in the cognitive conflict training, the chips were set up in one-to-one correspondence and their equivalence was established. But in contrast to the cognitive conflict training the experimenter immediately collapsed one side of the box and asked whether there were the same amount of chips on both sides. Regardless of the positive or negative responses of the subjects, the experimenter said the following rule while manipulating the box

accordingly: "Now I am moving them. See, they are standing in a different place, but there are as many chips as before. They only look different. See, I can put them back just the way they were, so you see, there are still the same number as before because I did not add any chips or take away any chips. I only moved them." In the next session, twenty chips of the same colour used in the preceding session were used, and in subsequent sessions, for each colour, first ten and then twenty chips were used.

Bruner: *Language Activation*—The language activation training involved three wooden boxes, each with two transparent parallel sides, two of which were identical, while the third was the same height but wider than the others, a screen, and twenty chips. Following the free play, using a one-to-one correspondence technique, the subjects filled one box with ten poker chips while the experimenter simultaneously filled the other identical box. The third box was placed with the two filled boxes behind the screen so that only their tops could be seen. The experimenter poured the chips from one of the filled boxes into the third unfilled, wider box. The child was asked whether there was the same amount of chips in the newly filled box as in the remaining previously filled box. The screen was removed and the subject was again asked whether the boxes held the same amount. Since one box was wider, the chips in it were spread out, and were therefore perceptually different from those in the narrower box. This training procedure was repeated for each of the three colour chips in subsequent sessions.

Post-Tests and Scoring of Responses

In order to test the effects of various training treatments, two non-verbal tasks in which the law of conservation of substance was violated, and one Piagetian test of conservation of substance were employed. Conservation of substance tasks were utilized because the previous investigators suggested that this concept could be induced utilizing their approach. Each subject was tested individually. The sequences in which the tasks were presented were counter-balanced to control for order effects. The criteria for the attainment of the concept of conservation of substance were stage three responses on *any two* of the three tasks.

Tasks

1. *Non-Verbal Continuous Task*: The first non-verbal experiment, the magic experiment for conservation of a continuous substance, consisted of first allowing each child to satisfy himself that two 150 ml. beakers contained the same quantity of liquid. The contents of one of the beakers was then poured into a 1000 ml. jar which it apparently filled. The

child gestures and reactions were noted. Gestures of surprise, puzzlement, smile, "wow" were scored at stage three, presence of conservation, whereas absence of observable changes in behaviour were scored at stage one, absence of conservation. The illusion was created by surreptitiously opening a valve connecting the empty 1000 ml. jar to one which was full and hidden behind the screen. The experimenter controlled the rate at which the visible jar filled.

2. *Non-Verbal Discrete Task*: The second non-verbal magic experiment, for a discontinuous substance, again violated the law on conservation; it assumed that a child who had attained the concept would recognize the violation. Two seemingly identical wooden boxes, one with a false bottom, and 26 gumballs were employed. Each child was told to put eight gumballs into the wooden box with the false bottom, one by one, as the experimenter put eight gumballs into the second wooden box. Under the false bottom in the child's box were an additional 10 gumballs. The child and the experimenter both poured the contests of their wooden boxes into two separate containers. When the contents of the child's box were poured, a latch released the additional ten gumballs. The child's reactions and comments to the gumballs in the containers were noted. Scoring of these responses was similar to those for the first post-test for continuous substance.

3. *Verbal Piagetian Task*: The third task was a typical Piagetian verval test for conservation of discrete substance. Each child was told to put eight gumballs into a 150 ml. beaker, one by one, at the same time the experimenter put gumballs into another 150 ml. beaker. The contents of one beaker were then poured into a 50 ml. graduated cylinder, while the contents of the second beaker were poured into a 600 ml. beaker. The child was then asked whether the quantities in each were the same.

The subjects in the four training conditions and two control conditions were tested one week, two months and six months after the last training session.

Results

Attempts to test hypotheses of "no difference" are replete with logical and statistical hazards. There are some who maintain that to demonstrate such a state is impossible. Others simply consider it extremely difficult. In presenting these results, it shall be understood that when the confirmation of a hypothesis of "no difference" is suggested, it is to be interpreted in the following way: The hypothesis that a large difference is demonstrable in this given situation is significantly improbable. Though this is awkward language, it remains appropriate to the objectives of this research and to the demands of statistical theory.

When the research hypothesis is, in fact, one of equality, it would seem quite inaccurate, to couch it in terms of an inequality only for purposes of statistical expediency.

In testing hypotheses of no difference we are primarily concerned with minimizing the likelihood of accepting this hypothesis when in fact there is a difference. In other words, we wish to minimize the probability of committing a Type II error. One way to minimize this probability is by fixing the alpha level of significance for hypotheses of no difference at 0.10. Fixing the level of significance at 0.10 rather than the normal level of 0.05 for a fixed N and for a fixed alternative reduces the probability of committing a Type II error. If for this fixed alpha level of 0.10, we still have no reason to reject the hypothesis of no difference, the likelihood of rejecting a false hypothesis is improved. When testing hypotheses which predict differences however, we return to the more commonly utilized 0.05 level of significance.

Since our data were clearly categorical the Chi-square statistic was utilized. The per cent of agreement between three judges on categoriz-

TABLE I

THE NUMBER OF SUBJECTS UNDER THE SIX CONDITIONS ON THE POST-TESTS, ONE WEEK, TWO MONTHS AND SIX MONTHS AFTER TRAINING RESPECTIVELY

	Control I	Control II	Beilin	Smedslund	Sigel	Bruner	Total	χ^2	P
First Post-Test (one week after training)									
Stage 1 (non-conserver)	16	13	12	14	18	13	86	6.48	$p > .10$
Stage III (conserver) *	4	7	6	6	1	6	30		(*n.s.*)
Total	20	20	18	20	19	19	116		
Second Post-Test (two months after training)									
Stage I (non-conserver)	16	11	11	13	15	9	76	6.3	$p > .10$
Stage III (conserver)	4	9	8	6	3	9	38		(*n.s.*)
Total	20	20	19	19	18	18	114		
Third Post-Test (six months after training)									
Stage I (non-conserver)	15	9	10	7	6	9	56	3.91	$p > .10$
Stage III (conserver)	3	7	6	8	5	7	36		(*n.s.*)
Total	18	16	16	15	11	16	92		

ing the responses on the three tasks was 90%. The average number of training sessions was 7 for all training conditions.

Table I shows the results of the performance of the subjects under six conditions on post-tests one week, two months, and six months after training respectively.

A 2 x 6 Chi-square for each post-test session indicated that children who had training did not out perform children who did not have training, and further, that the pre-tested control group did not out perform the non-pretested control group. Accordingly, the cognitive conflict hypothesis was rejected whereas the other three hypotheses were confirmed.

Table II represents a more detailed description of the results for children who attained stage III responses on the three conservation tasks for the three testing sessions. It appears that on all three testing session non-verbal discrete tasks were easier than the verbal tasks and the non-verbal continuous task.

TABLE II

NUMBER OF CHILDREN WHO ATTAINED STAGE III RESPONSES ON EACH TASK FOR THREE POST-TEST PERIODS

Task	Post-test 1st (2 weeks)	2nd (2 months)	3rd (6 months)
Verbal Discrete	19	16	23
Non-Verbal Discrete	30	38	32
Non-Verbal Continuous	15	32	30

Table II does not indicate whether the same children who attained stage III on the first post-test also attained stage III on the second or third post-test. The question arose whether any children, who attained stage III on the first post-test, did not attain stage III on the second or third post-test. In other words, were there any reversals?

TABLE III

NUMBER OF SUBJECTS WHO MADE REVERSALS FOR EACH OF THE THREE TASKS ON THE THREE POST-TEST

Tasks	PF	PPF	PFF	FPF	PFP
Verbal Discrete	1	3	7	4	3
Non-Verbal Discrete	3	6	1	3	1
Non-Verbal Continuous	2	1	3	5	0

Table III indicates the number of subjects, who made reversals from the first post-test to the second and third post-test on the three tasks. The relevant reversals are: Passing the task on the first post-test and failing the task on the second post-test (PF), (these were for subjects who were post-tested twice only), passing the task on the first post-test and second post-test and failing the task on the third post-test, (PPF),

passing the task on the first post-test and failing the task on the second and third post-tests (PFF), failing the task on the first post-test, passing the task on the second post-test and failing the task on the third post-test (FPF), and passing the task on the first post-test, failing the task on the second post-test and passing the task on the third post-test (PFP) Passing an item meant a stage III response whereas failing an item meant a stage I response.

Inspection of Table III reveals several reversals from one post-test to another. These results suggest that the reliability of the individual measures may be open to question or that the trait itself may not be stable. Because of these difficulties the Kruskal-Wallis One Way Analysis of Variance, utilizing an average score of the subjects' responses on the three tasks over the three post-tests, was used to also test the hypotheses. This analysis ($H = 4$ with df 5, $P < .20$) supports the results of the Chi-square analysis described in Table I.

Discussion

Not only is it necessary to explain the failure of Smedslund's cognitive conflict training technique for conservation, but it is also necessary to explain why training in general for conservation appears unsuccessful. Perhaps an explanation of the criteria for demonstration of the effectiveness of training of conservation of substance is appropriate. According to Piaget (1964) for training in conservation to be effective two criteria have to be satisfied. These are *generalizability* and *durability*. In other words, the concept which was induced not only had to transfer to other situations, but the concept should not extinguish over time. Clearly post-testing for *violations* of the concept of conservation over a period of six months satisified the forementioned criteria. Whereas the criteria in these experiments satisfied Piaget's criteria this was not the case in any of the other training studies. In Beilin's training study, the generalizability criterion for testing whether the concept was induced was extremely limited and durability criteria was not satisfied at all. Similarly in Smedslund's and Bruner's experiments the durability criterion was not met, whereas the generalizability criteria was limited. In Sigel's technique although the generalizability factor was met, the durability factor was not. Because these investigators employed different criteria, it is conceivable that the success in training that Beilin, Bruner, Sigel and Smedslund report relates not to the concept of conservation of substance as Piaget sees it, but rather to some other concept or some deformation of the concept of conservation. In support of the forementioned explanation of the consequences of not employing similar criteria, Gruen demonstrated that the different criteria and the different procedure employed by Bruner and Smedslund led to a different classification of conserving responses. Obviously then,

different criteria for testing presence of the concept of conservation of substance provide explanations for the lack of success of training by any one of the training techniques.

It was mentioned earlier that the training methodology employed by Beilin, Bruner and Sigel are generally inconsistent with the Piagetian position and that this might explain the results. This point shall be elaborated on shortly. Prior to this a further explanation is necessary to account for Smedslund's results. Although it is true that the cognitive conflict position is consistent with Piagetian theory, there is one difference which may provide an explanation of the Smedslund training results. Smedslund now suggests that the organism-object conflict which he espoused is not of sufficient moment to cause a modification of the intellectual structures. He further suggests that the organism-object relation is too neutral for the child and does not or cannot create the conflict in the child. As an alternative he argues for an organism-organism conflict. In other words a confrontation of different points of view among children as a necessary condition for modification of intellectual structures. Clearly, such a shift in position by Smedslund now makes his position identical to Piaget's rather than similar to Piaget as mentioned earlier.

Piaget's position on the syncretic nature of child's thought with its behavioural manifestation of juxtaposition suggests another possible explanation of the ineffectiveness of the training. If the child's thought manifests itself by linguistic confusion such as juxtaposition then, the language dimension of the training procedure may provide an obstacle rather than facilitate acquisition of the concept. Clearly, because of the apparent ineffectiveness of the training techniques, it is likely that the language employed in the various training techniques did not facilitate acquisition of the Piagetian concept of conservation of substance. Not only is there no indication that the language provided any facilitation but the language may have hindered acquisition of this concept. More specifically, the Sigel training technique (Table 1, first post-test), which required more language than the other training technique, appeared to be the least effective method for attaining the concept of conservation.

Perhaps two examples will highlight the possible interference of language in concept acquisition. A child in the first post-test on the nonverbal discrete item claimed emphatically that the marbles in both containers were the same, even though one container had thirty marbles while the other container had ten marbles (a non-conserving response). On the second post-test this child returned to the "perceptually" more appropriate response of claiming that the marbles in both containers were not the same number (a non-conserving response). In a second example, there were several instances when children were confronted with two rows of eight chips. At first they acknowledged their equality

but when they began to count numbers of chips they lost sight of their equality and they then maintained that the rows were not equal. Consequently, it appears that the language aspect of the training may not be inappropriately applied (example 1) but that also the mere act of verbalizing may interfere with concept acquisition (example 2). Accordingly, such evidence is contrary to the position that language facilitates concept acquisition.

Because of the apparent lack of the effectiveness of various kinds of specific training, it becomes necessary to make explicit how specific training differs from cumulative life experiences which Piaget suggests are in part the determining factors for acquisition of the concept of conservation of substance.

Besides the obvious differences of time between cumulative life experiences and specific training, the ordering of experiences must be considered a relevant distinction. Clearly, the nature of *any* specific training involves a *deliberate,* ordering of experiences. In other words, the sequence of presentation is paramount. The assumption here is that the child will assimilate the relevant aspects (order, etc.) of these experiences and consequently acquire the concept. But this assumption is not tenable within a Piagetian framework. For if the child constructs his reality, then it does *not* necessarily follow that he will assimilate the material in the *order* presented to him. Accordingly, it is conceivable that the child will assimilate the material in a different order and will utilize the language differently from the way it is presented (namely inappropriately).

Although the results lend credence to the limited utility of training and to the possbile interference of language, it is clear, particularly from Table III that more research is needed to account for the reversals from one post-test to the next.

The reversals need to be accounted for either by some theoretical explanation or the possible methodological difficulties described next need to be answered. To begin with these reversals may be indicative of inherent unreliability of not only the Piagetian items, but also the Mermelstein non-verbal items. Hence the need for the construction of a reliable conservation test. Secondly, the reversals may be in part a function of experimenter bias over the three post-tests. Experiments controlling this factor are needed. Thirdly, these reversals may indicate that the concept of conservation is a transitory phenomenon within a given age range; here today and gone tomorrow. The importance of longitudal studies in this instance is obvious. Fourth, the reversals may be a function of the transitional stage, stage II. Accordingly, there is need for a more careful examination of this period. Clearly then, not only does the choice of criteria, as Gruen and we maintain, influ-

ence the absence or presence of the concept but the items which constitute the criteria may influence the absence or presence of the concept. Thus, the problem as Gruen describes may be fundamentally a theoretical and methodological one.

Conclusions

It is concluded that the "Piagetian" concept of conservation of substance, as measured by the specific criteria described, was *not* induced by a variety of training techniques. Further it is suggested that language interferes with rather than facilitates acquisition of the concept of conservation of substance. Finally, it is concluded that the problems of reversals merits further exploration.

REFERENCES

[1] Jerome Bruner, "The Course of Cognitive Growth", *American Psychologist,* January, 1964.

[2] Irving Sigel and Annemarie Roeper, "The Acquisition of Conservation, A Theoretical and Empirical Analysis", (unpublished).

[3] Harry Beilin, "Learning and Operational Convergence in Logical Thought Development" *Journal of Experimental Child Psychology,* Vol. II, 1965, pp. 317-339.

[4] Jan Smedslund, "The Acquisition of Conservation of Substance and Weight in Children, III; Extenstion of Conservation of Weight Acquired "Normally" and by Means of Empirical Contrast on a Balance Scale", *Scandinavian Journal of Psychology,* 1961.

[5] J. R. Wohlwill, "A study of the Development of the Number Concept Scalogram Analysis", *Journal of Genetic Psychology,* 1960, p. 97, pp. 345-377.

[6] Harry Beilin and Irene Franklin, "Logical Operations in Area and Length Measurement, Age and Training Effects", *Child Development,* Vol. XXX, 1962, pp. 609-618.

[7] Barbara Prager, "The Effects of Cognitive Conflict on the Acquisition of the Concept of Conservation", (unpublished study).

[8] Egon Mermelstein and Lee Shulman, "Lack of Formal Schooling and Acquisition of Conservation", *Child Development,* March, 1967.

[9] Jacqueline Goodnow, "Piaget's Tasks: The Effect of Schooling and Intelligence", *Child Development,* September, 1966.

[10] Dr. Price-Williams, "Abstract and Concrete Modes of Classification in a Primitive Society", *British Journal Educational Pyschology,* Vol. XXXII, 1962 pp. 50-61.

[11] Smedslund, *loc. cit.*

[12] Smedslund, *loc. cit.*

[13] Gerald E. Gruen, "Note on Conservation: Methodological and Definitional Considerations", *Child Development,* December, 1966.

[14] Bruner, *loc. cit.*

[15] L. Wallach and R. L. Sprott, "Inducing Number Conservation in Children", *Child Development,* Vol. XXXV, 1964, pp. 1057-1072.

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A replication of Piaget's study of the influence of the mode of presentation of material or comprehension. In this study a tape recorder was used to maintain greater uniformity of presentation among subjects. The author suggests that factors other than the ego-centrism of children postulated by Piaget may be significant variables.

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Factors Affecting the Listening Comprehension

In Piaget's experiment on the understanding between children[1] the difference between the comprehension of a child who listens to an adult read a story and the comprehension of a child who listens to a peer tell the same story is very striking. Piaget considers that the ego-centricism of the children causes the speaker to explain the story without paying any attention to the listener who, in his turn, does not listen attentively because, in his ego-centricism, he is confident that he understands.

Berg[2] has pointed out that listening comprehension may be affected by several factors that are difficult to measure. These are: the voice and mannerisms of the speaker; the interplay between the speaker and the listener; and the rate and manner of delivery of the material. Possibly, these factors may have been affecting differentially the two listening situations, adult-child and child-child, in Piaget's experiment.

The importance of the factor, manner and rate of delivery, was recognized by Piaget. In his experiment, the adult read the story to the child with rhetorical effect. When the child told it he made frequent long pauses interspersed with rapid speech and he made no attempt to stress significant words or phrases. While Piaget regards this method of presentation primarily as evidence of the child's ego-centricism he also admits that it made the listener's task harder.[3] He appears to agree with Thompson that: "It is often not *what* is said but *how* it is stated that carries the greatest meaning to the listener."[4] This is

further elaborated by Dearborn *et al.* as a result of their investigation of the relationship between stress in oral reading, and meaning. In describing the antithesis of Piaget's child raconteurs they stress the importance of manner of presentation: "It is clear. . .that vocal stress supplies the listener with information over and above the information he would receive if speech were conducted in monotones and at an unchanging rate."[5]

Berg's second factor, the interplay between speaker and listener, also varies depending on whether the child listens to an adult or to a peer. A number of studies on children's speech have shown that the content and usage of language varies according to the social situation in which it is recorded.[6, 7] Although there seem to be no comparable studies on the effect of the situation on the child's listening, it can be hypothesized that by ages six and seven the child has learned to listen with attention to an authority figure in the school situation. If he does not listen the consequences are often unpleasant. By contrast, listening to a peer may assume less importance. Piaget's subjects comprehended quite well, apparently showing little ego-centricism, when they listened to the experimenter: it was when they listened to a peer that ego-centricism became marked and was reflected in lower comprehension scores.

The voice and mannerisms of the speaker, Berg's first factor, also varied for the adult-child and child-child situation. These variables in Piaget's study were not controlled.

In Piaget's experiment there was a further difference in the two listening situations. The adult repeated all or parts of the story if necessary until the child showed that he understood. When the child told the story, the listener heard just one presentation with no extra explanations or repetitions.

The purpose of the present investigation was to control these variables while repeating part of Piaget's experiment: The number of presentations of the story was held constant, and the voice and mannerisms of the speaker, and interplay between speaker and listener, were controlled by using a recording. Manner of presentation was controlled to compare the effect of changes in presentation on the child's comprehension of, and retelling of, a story. One presentation simulated story-telling with rhetorical effect, one simulated the child story-telling, and the third was a presentation in "monotones and at an unchanging rate."[8] Concomitant with the change in manner of presentation was change in rate of delivery.

It was hypothesized that if manner of presentation is an important variable affecting a child's listening comprehension of a story, when other variables are controlled those subjects listening to the "rhetorical" presentation should have higher comprehension than those subjects lis-

tening to either the "child-type" presentation or the monotone, both of which have been postulated to impede listening comprehension.

It should follow that a high γ ratio (what the child comprehended in relation to the original points of the story told him by the adult) close to that reported by Piaget should be obtained for those children who listened to the rhetorical presentation. The lower β ratio (what a second child comprehended in relation to what another child told him) close to Piaget's β ratio should be obtained for those subjects who listened to the "child-type" presentation. The monotone presentation did not parallel one of Piaget's listening situations.

Method

The effects of three treatments of one independent variable, manner of presentation of the material, and a second independent variable, sex difference, were compared for two dependent variables: comprehension of the story, and story points actually expressed. Interaction of sex difference and manner of presentation was also determined for each dependent variable.

Subject

The subjects were chosen from the school used in a replication of Piaget's experiment.[9] From those grade-one children who had not taken part in the replication, 30 boys and 30 girls were chosen randomly and the subjects of each sex then randomly assigned to three groups, A, B and C. The mean CA (in February 1966) for both boys and girls was six years nine months. The mean IQs and the standard deviations for boys and girls on the Detroit Beginners First Grade Intelligence Test were 117.3 and 15.8, and 116.9 and 14.6, respectively: the mean IQ for grade one Calgary children on this test is 112.

Materials

One story, *Niobe* was used for each manner of presentation. *Niobe* was chosen because this story was used by Piaget, it was unknown to the subjects, and it had been shown in the replication to be less difficult for grade one children than Piaget's other unknown story, *The Four Swans.* A boy of ten, who was a competent reader, told the story of *Niobe* in three different ways and his three presentations were recorded on tape. The use of a tape recorder, although changing Piaget's face-to-face listening situation,[10] did produce a listening situation identifical for all subjects.

The boy first read the story as effectively as he could, stressing the significant words and reading in a fairly measured rate though with small variations for rhetorical effect. This reading took 45 seconds.

He then read the story again word by word in a monotone and at an unchanging rate. This was achieved by writing the words of the story in the correct order in vertical lines as in a spelling list. A cardboard marker uncovered the words at a regular rate as the boy read them. This reading took 1 minute 45 seconds.

For the third presentation, a tape recording (from the replication[11]) of the story told by a child who expressed all the points in correct order was transcribed with the pauses and comments such as uh, er, etc. recorded. The reader listened to the tape recording several times and then read the transcription following the manner of presentation of the original as closely as possible. The time of this reading was 1 minute 31 seconds.

Record sheets listing all the 12 "story points" of *Niobe* (as given by Piaget) and 12 comprehension questions pertaining to each "story point" were also prepared.

Procedure

Two subjects of the same sex were brought together for testing. One remained in a waiting area and played with puzzles and drawing materials. The other was taken into the testing room and told that he would play a game of telling stories. He was shown the tape recorder and it was explained that it was like a small record player. The experimenter then said, "This tape recorder has inside it a record of a boy telling a story. I am going to play this record and I want you to listen very carefully while the boy tells the story. Then we shall ask ". . . . ." to come in here and you will tell him the same story that you have just heard on the record." When the subject said that he understood what he had to do, the tape recorder was started. Subjects in group A listened to the rhetorical presentation, those in group B heard the monotone, and those in group C the child-type presentation.

The child waiting outside then came into the testing room and the subject told him the story. As he did so the experimenter recorded the points expressed on a record sheet. The child who had served as the audience then returned to the classroom while the experimenter asked the subject comprehension questions on the points he had omitted in his story-telling and recorded the answers. Finally, the subject was asked what kind of a person had told the story on the record.

The subject then went to the waiting area and became the audience when a new subject retold the story.

Results

The means for the dependent variables, story points expressed and total comprehension (points expressed plus the score on the comprehension questions), are given in Tables I and II.

TABLE I
MEANS OF POINTS EXPRESSED FOR TREATMENTS[1] AND SEXES

Sex	Treatment		
	A	B	C
Male	4.5	2.5	4.3
Female	3.7	3.4	3.3
Total	4.1	2.9	3.8

[1] A: Rhetorical presentation
B: Monotone presentation
C: Child-type presentation

TABLE II
MEANS OF TOTAL COMPREHENSION FOR TREATMENTS[1] AND FOR SEXES

Sex	Treatment		
	A	B	C
Male	7.8	5.9	6.6
Female	7.1	5.9	4.6
Total	7.5	5.9	5.6

[1] A: Rhetorical presentation
B: Monotone presentation
C: Child-type presentation

The differences between these means and the interaction between sex differences and treatments were tested for each dependent variable by means of a two-way analysis of variance. None of the Fs was significant.

The means for points expressed (Table I) for treatments A and B for male subjects were compared by a t-test: the difference was significant at the .05 level. There was no significant difference between any other pairs of means in Table I.

The relationships between Detroit IQ and total comprehension scores for groups A, B, and C were measured by Pearson product-moment correlation coefficients. They were:

	Group A	Group B	Group C
Detroit IQ	0.45	0.11	0.23

The correlation between IQ and group A is significant at the .05 level. For groups B and C the correlations are not significant.

Two of Piaget's ratios, γ (total comprehension in relation to the total points in the story), and δ (what the subject expressed in relation to his total comprehension), were also calculated. The mean ratios for treatments and Piaget's mean ratios are given in Table III. The sig-

nificance of the difference between these means could not be tested as, apart from means, Piaget gives no other data.

TABLE III

γ AND δ MEAN RATIOS FOR TREATMENTS AND FOR PIAGET'S EXPERIMENT

Ratio	Treatments			Piaget
	A	B	C	
γ	0.62	0.49	0.48	0.70
δ	0.51	0.44	0.72	0.87

γ: Total comprehension in relation to total points in the story.
δ: What the subject expressced in relation to his total comprehension.

When the replies to the question "Who was telling the story" were categorized, the frequencies of the different answers were: a boy, 54: a girl, 2: a man, 2: the fairy, 1: Little Miss Muffet, 1.

Discussion

When other variables in the listening situation are controlled, it appears that the manner of presentation of the story makes no significant difference to either the number of points from the story that a child is able to express or to comprehension of the story.

An examination of the means for total comprehension (Table II) does show that group A, who listened to the rhetorical presentation, had a higher mean than the other two groups whose means were about the same. The F ratio between treatments for total comprehension was 2.90, and 3.17 was required for significance at the .05 level. One further "story point" gained by one subject of group A was required to make the F between treatments significant.

A further corroboration of the better comprehension of the rhetorical presentation is shown by the significant relationship between IQ and comprehension for group A. In the other two groups there was no relationship, showing that the more intelligent children found it hard to comprehend the material, achieving no more success than children with lower IQs.

In the present study, one ratio of points comprehended in relation to total story point (γ) was computed. Piaget had two ratios: γ for the adult-child listening situation and β for the child-child listening situation. The ratio for treatment A reflects the higher scores in this group but all the γ ratios of the present study are lower than Piaget's result. The γ ratio for A (rhetorical presentation similar to the type of presentation in Piaget's adult-child situation), is essentially the same as the

β ratio of 0.61 reported by Piaget in his child-child situation where presentation was similar to treatment C.

For groups A and B the ratios of points expressed to total points comprehended (δ) are very much lower than Piaget's ratio. They also are closer to the ratio of the two scores for the child-child listening situation. This ratio is not reported by Piaget, but for the replication[12] it was found to be 0.44. The ratio of group C is nearer to Piaget's figure. In discussing the factors in understanding between children, Piaget put forward a hypothesis, which he later rejects, that children "will understand each other better (being used to the same way of thinking) than they understand us".[13] For total comprehension, as Piaget also showed, this hypothesis is not substantiated, but in this investigation, when other listening factors were held constant, children recalled unaided more of the material presented in the child-type spoken language than in the written language of an adult. For example, the clause, "Then the fairy got quite mad," from presentation C was more often recalled than, "Then the fairy was very angry," which was the form in A and B.

The analysis of variance showed no significant differences between the sexes for either score, and in general in this study the girls did not show the slight superiority over the boys found in the replication. An exception was the significantly lower mean of the boys for treatment B compared to treatment A for story points expressed. The boys appeared to find it more difficult to retell the story after hearing the monotone than after hearing the more "natural" presentations of either C or A: girls did not show this treatment difference. However, during the experiment, four girls who heard the monotone presentation retold the story in a word-by-word manner imitating the recording. These findings are interesting with respect to an earlier grade-one investigation with children from the same area of Calgary which showed that practically all children read orally in a word-by-word manner and that girls were consistely superior to boys in reading achievement.[14]

The children seemed to accept the experimental materials as nothing unusual and the manner of presentation of the story caused comment from only three subjects. Piaget who also noted the listener's uncritical acceptance of all they heard, suggested that "scholastic habits" may be one cause.[15] The children were not only quite sure that they were listening to a boy, but from such comments as, "Is that boy in our class?" seemed to regard the voice as that of a peer.

When there is control of such variables in the listening situation as voice and mannerisms of the speaker, interplay between speaker and listener, and number of presentations of the material, the manner of presentation of the material appears still to be of importance. Children who listen to well-written material presented with rhetorical effect understand it better than those who listen to the same material presented

in a monotone and at unvarying rate, or the same material retold from memory by another child. This comprehension difference would possibly show more clearly with a larger sample and a less difficult story.

However, it seems likely that the controlled variables in this experiment were exerting a differential effect in Piaget's adult-child and child-child listening situation from the fact that the scores and ratios for group A (rhetorical presentation) are like the results Piaget obtained in the child-child situation. Since the manner of presentation was exerting an effect the B and C results are even lower than Piaget's child-child ratios.

It may be that Piaget's children evidenced ego-centricism in the manner in which they retold the story. But the low ratio of understanding between children may have been due as much to other factors which varied between the adult-child and the child-child situations as to the ego-centricism of the children.

Summary

Certain factors, which had varied between an adult-child and a child-child listening situation in Piaget's experiment on understanding between children, were controlled in the present study. A further variable, manner of presentation of material listened to, was varied and compared for three different types of presentation.

A well-read story was better comprehended than the same story presented in a monotone and at an unchanging rate, or than the story retold by a child. The other controlled variables also exerted an effect since the comprehension of subjects who listened to the well-read presentation was the same as in Piaget's child-child listening situation.

REFERENCES

[1] J. Piaget, *The Language and Thought of the Child* (London: Routledge & Kegan Paul, 3rd ed., 1959), Ch. III.

[2] P. C. Berg, "Reading in Relation to Listening," in O. S. Causey (Ed.), *The Reading Teacher's Reader* (New York: The Ronald Press Co., 1958), pp. 22-26.

[3] Piaget, *op. cit.*, p. 100.

[4] G. G. Thompson, *Child Psychology* (Boston: Houghton Mifflin Co., 2nd ed., 1962), p. 356.

[5] W. F. Dearborn, P. W. Johnston and L. Carmichael, "Oral Stress and Meaning in Printed Material," *Science,* CX (1949), p. 404.

[6] Dorothea McCarthy, "A Comparison of Children's Language in Different Situations and its Relation to Personality Traits," *Journal of Genetic Psychology,* XXXVI (1929), pp. 583-591.

[7] R. M. Williams and M. L. Mattson, "The Effect of Social Groupings Upon the Language of preschool Children." *Child Development,* XIII (1942), pp. 233-245.

[8] Dearborn, *et al., loc. cit.*

[9] Mary H. Neville, "A Replication of Piaget's Experiment on Understanding Between Children of the Same Age," *Alberta Journal of Educational Research* (see this issue Pp. 221-229).

[10] Berg., *loc cit.*

[11] Neville, *loc. cit.*

[12] *Ibid.*

[13] Piaget, *op. cit.*, p. 119.

[14] Mary H. Neville, "The Effect of Silent Reading, Oral Reading, and Listening on Accuracy and Comprehension in Beginning Reading" (Unpublished Master's Thesis, University of Alberta at Calgary, 1965)

[15] Piaget, *loc. cit.*

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Three forms of factor analysis, including oblique transformation, were used to investigate the nature and role of Piagetian reversibility in operational thought among 85 nine-year old boys. It was found the reversibility appeared to take two forms which were not related within the sample and which were consistent with Piaget's description of inversion and reciprocity.

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A Factor Analytic Study of Piagetian Reversibility

Jean Piaget has claimed that reversibility is the acme in which growth of intelligence culminates.[1] Perception, verbalization, actions, are unrecallable entities which may linger to colour subsequent actions, but once gone they are gone forever. A thought, however, can be invoked, entertained and then revoked—banished from the cognition as though it had never existed. Difficult, costly, dangerous solutions to problems can be considered and evaluated without a momentary qualm. Regardless of how "way out" an idea is, its implications may be considered without threatening the essential coherence of conceptual systems.[2] Thought represents a world relatively free from centration. It is free of the limitations imposed by perception because, in Piaget's view, thinking has the property of reversibility.

Thought processes require structures which permit mobility without resulting in disequilibrium. Piaget sees such processes as free to move rapidly from one idea to another, arranging them in new combinations while preserving stable concepts of the world at large.[3]

The "dynamic equilibrium" which Piaget attributes to thought can perhaps best be compared with that of a lift and its counterweight. The lift can move freely up and down, and the system remains intact and in equilibrium, no matter what floor is reached. This is because of its re-

versibility; any movement of the lift is compensated by an equal and opposite movement of the counterweight, and it can also be nullified by an equal and opposite movement of the lift.[4]

Piaget sees operational (logical) thought emerging upon the organization of a basic set, or stock, of concepts into coherent systems. This, he believes, takes place first in the period of concrete operations which occurs between the ages of seven years and eleven years.[5] Operations are so named because they are "internalized responses." Systems of such operations are called *"groupements,"* whose stability depends upon the possession of five properties: closure, reversibility (inverse and reciprocal), associativity, identity, and the dual property of tautology and iteration. Supplying flexibility of hindsight and foresight is the property of reversibility which, Piaget suggests, forms the basis for understanding logical relationships. Inhelder and Piaget have written that operational reversibility arises out of the individual's flexibility in changing criteria, either because he notices some property of which he previously failed to take account, or because new elements are added to his environment.[6] Flexibility of foresight occurs when there is mental anticipation of a classification or connection before it is put into practice and particularly when the best classification is chosen from a number of possible alternatives without trial and error. The present authors suggest that flexibility of foresight and hindsight might be regarded as the psychological correlate of reversibility, and as such may be quantifiable. This would permit an investigation of the development of operational reversibility and its role in intellectual functioning.

In Piaget's view, the solution to any problem requires the possession of schemata by or through which the person involved perceives his world and constructs a symbolic representation of it. This symbolic version is considered amenable to formal, active reasoning. It is implied that the level of intelligence will depend upon the skill with which formal, active reasoning is carried out.

At the level of concrete operations, and subsequently in formal operations, manipulation of schemata is seen to be a continuation of actions expressing certain forms of co-ordination general to all actions, and in time taking on an autonomy which transcends the perception, language and maturation factors through which schemata are developed. The most general characteristic of operational thought is said to be reversibility.[7]

Problem

If reversibility is indeed the most general characteristic of operational thought, it seems possible that it will appear as a factor in problem solving processes at the operational levels. Further, it might be expected that the supposed factor of reversibility would be of major import-

ance in the solution of typical Piagetian tasks administered to children in the concrete operational stage. Accordingly, the prime objective of this study was an investigation of the possible role and nature of reversibility in operational thought among nine-year-old boys.

Methods

Sample

The sample was drawn from all Canadian born boys presently enrolled in Grade III in Garneau, Queen Alexandra, and Laurier Heights elementary schools of the Edmonton Public School Board. Eighty-five subject comprising 90% of the population of boys were tested. The full sample mean age was 8 years 6 months with a SD of 3.6 months. The age range was 8 years 0 months to 9 years 6 months, however, all but three of the boys were aged between 8 years and 8 years 10 months. Mean IQ on the Otis Total Alpha (S) was 109 and IQ ranged from 72 to 141. Some description of the socio-economic status of the sample was obtained through use of the Canadian Occupational Scale[8] Mean occupation rating was 58.3. SD was 11.6 and occupation ratings ranged between 30.0 and 82.6. Consequently the sample was considered to be heterogeneous in regard to occupational level, and socio-economic status generally.

Procedures

Fifteen tasks were drawn together from three interpretations of Piaget's clinical methods.

1. Vernon's adaptation of Piagetian tasks.[9]

Vernon has conducted a series of investigations using a number of tasks adapted from the procedures of the Geneva School. As a result, some quantification has been possible in the area of conservation, number and visualization. Included in the present battery are: Time concepts; Equi-distant counters; Logical inclusion; Visualizing water in a tilted bottle; Conservation of volume in a liquid; Conservation of volume in a solid; Visualizing an insect in differing positions; Number concepts; Conservation of length of rods; Position and size of shadow; Conservation of area.

2. Towler/Piaget Tasks.

One test was used from a battery of measures described by Towler.[10] The selected task, Natural axes, contains nine items and yields a total possible score of 18 points, since each item has two parts.

3. Inhelder/Piaget Tasks in Flexibility of hindsight and foresight.

Three tasks were adapted by O'Bryan[11] from those described by Inhelder and Piaget. All the tasks were administered and scored according to instructions suggested by their respective adaptors.

Three forms of factor analysis, Principal axis, Varimax orthogonal rotation, and Promax oblique transformation, were applied to the responses. In view of the possible generality of reversibilty in the data, loadings on the Principal axis factors and coefficients derived from the Promax transformation were used as the principal sources of evidence for the identification of the factors.

Results

Tables I and II respectively show loadings on the Principal axis unrotated factors and Promax coefficients in an oblique solution. Table III displays the correlations between the Promax primaries.

TABLE I
PIAGETIAN TASKS UNROTATED PRINCIPAL AXES FACTOR LOADINGS

Variables	FACTOR LOADINGS I	II	III	IV	V	VI	Communality
1. Time	.085	−.163	−.213	.508	−.460	.036	.550
2. Counter	.416	.048	−.031	−.611	−.080	−.442	.752
3. Inclusion	.086	.178	.084	.119	−.681	−.551	.827
4. Tilted Bottle	.076	−.507	−.519	.289	.233	−.172	.699
5. C.V. Liquid	.368	.342	−.342	.175	−.434	−.251	.651
6. C.V. Plasticine	.471	.150	.346	.631	−.016	−.115	.776
7. Insect	.234	−.698	−.268	−.115	−.035	.131	.645
8. Number	.165	.158	.674	.169	−.248	−.303	.689
9. Cons. Length	.151	−.381	.422	−.245	−.209	.055	.452
10. Shadow	.390	−.490	.024	−.222	−.129	−.247	.520
11. Cons. Area	.399	.315	−.520	−.073	−.131	−.159	.576
12. Towler Tasks	.334	−.554	.004	−.259	−.322	.016	.589
13. Flex. H/s (a)	.709	.097	−.089	−.025	.216	.065	.571
14. Flex. H/s (b)	.587	.267	.037	−.007	.232	.433	.658
15. Flex. F/s	.810	.058	.110	−.038	.125	.171	.718
Percentage of Total Variance	17.2	12.3	10.4	9.2	8.6	6.8	64.5

Factor I was identified as a reversibility factor type A defined by high coefficients on the Inhelder/Piaget tasks of Flexibility of hindsight (a) (.658), Flexibility of hindsight (b) (.854) and Flexibility of foresight (.770). The only other task with a coefficient above .3 was Conservation of volume in plasticine (309). On the other orthogonal rotation, this factor accounted for 22% of the common variance.

Piaget, in considering the development of *groupements* which express the totality of operations at the psychological level of concrete operations, writes that "these various groupements exhibit two very distinct forms of reversibility."[12] He names one *inversion*, the other *reciprocity*, and goes on to state:

> Inversion is the form of reversibility concerned with the operations of classes, and reciprocity the form concerned with the operations of re-

lations. No groupements are present at the level of concrete operations to combine these two kinds of reversibility into a single system. From the standpoint of mental development, inversion (negation or elimination) and reciprocity (symmetry) are already to be seen at the lower developmental levels. At the level of concrete operations, they appear in the form of two distinct operational structures (groupements of classes and groupements of relations), and finally form a unique system at the level of propositional operations.[13]

In view of the classification tasks involved in the Inhelder Piaget battery, the label Reversibility A was applied to the dimension represented by Factor I. It seems possible that this factor may be reflecting the operation of inversion.

TABLE II

PIAGET TASKS: PROMAX PATTERN ON THE PRIMARIES

Variables	FACTOR COEFFICIENTS I	II	III	IV	V	VI
1. Time			.481			
2. Counters					.937	
3. Inclusion						1.014
4. Tilted Bottle		.835				
5. C.V. Liquid			.845			
6. C.V. Plasticine	.309			.753		
7. Insect		.653				
8. Number				.820		
9. Cons. Length		.341				
10. Shadow					.533	
11. Cons. Area			.672			
12. Towler Tasks		.670				
13. Flex. H/s (a)	.658					
14. Flex. H/s (b)	.854					
15. Flex. F/s	.770					

Note: Coefficients below .30 omitted.

TABLE III

CORRELATIONS BETWEEN PROMAX PRIMARIES FOR PIAGETIAN TASKS

Factor	I	II	III	IV	V	VI
I	1.0					
II	.080	1.0				
III	.167	−.013	1.0			
IV	.130	.210	−.116	1.0		
V	.177	.163	−.277	.128	1.0	
VI	.076	−.251	.189	−.262	−.320	1.0

Factor II was identified as a reversibility factor type (B) defined by high coefficients on Towler Tasks (.670), Tilted bottle (.835) and Insect (.635). Only Conservation of length had a coefficient in excess of .300. The rationale underlying the naming of this factor as an op-

erational statement of reciprocity, or reversibility in *groupements* of relations, stems from several references by Piaget and Inhelder[14] to the necessity for a child to return to the identity operator by way of the reciprocal in tasks requiring visualization of relationships in concrete data. Since every task with substantial coefficients on this factor requires a reference to a model and construction of a response based upon the transformation of that model, it is supposed likely that this involves considerable formal or concrete operational use of the reciprocal operator. It is suggested that more is involved in the task than visualization of the sort used in space relationship tasks of the *Differential Aptitude Tests* type, since the subject is actually required to transform the stimulus rather than select a transformation from a number of provided alternatives.

Factor II accounted for 18 percent of the common variance on the basis of the Varimax rotation. Correlation between the first and second factors was negligible at .08, so it seems likely that they are indeed separate and distinct dimensions.

Factor III showed high correlation coefficients on Conservation of liquid (.845), Conservation of area (.672) and Time concepts (.481). The percentage of common variance represented by this factor was 16 percent (Varimax). On the basis of the content and supposed processes involved in the tasks, Factor III was identified as a Conservation of liquid and area factor. It had a slight positive correlation with Factor I (.167) and negligible correlation with Factor II.

The fourth factor was identified as Number on the grounds of very high coefficients on Number (.820) and Conservation of plasticene (.753). This factor appears to represent an ability to perceive numerical relationships and transform them without loss of identity. As such it would be expected to correlate with Factor II. This is in fact the case, although the coefficient is small (.210). No method yet exists to determine whether this correlation is significantly different from one occurring by chance. The Varimax rotation shows Factor IV accounting for 16 percent of the common variance.

The fifth factor shows high coefficients on counters (.937) and shadow (.533) and was considered to be a decentration factor. Shadow appears to require a form of decentration described by Inhelder and Piaget when they write:

> In order to imagine perspectives the child must distinguish his own viewpoint from those of others and coordinate it with theirs (decentration). In the case of shadows the light corresponds to the observer's viewpoint while the shadow is, in a sense, the negative of this. That is, the shadow is what cannot be seen from the place where the light is . . .[15]

Counters require the envisioning of an infinite number of points in

lineal relationship which Inhelder and Piaget claim is "essential to the completion of a qualitative concept of topological space".[16] Such a completion requires decentration.

Notwithstanding the above, it is felt that the identification of Factor V must be regarded as very tentative.

Only two tasks showed high coefficients on Factor VI, Time (.313) and Logical inclusion (1.014). The latter was so substantial that an attempt to identify the factor was made.

The task appears to require the subject to separate parts from whole. Vernon[17] linked Logical inclusion with conservation tasks generally but in the present sample it failed to correlate above .18 on any other factor. The factor it represents shows negative correlations with numerical conservation (-.26), visualization (-.32), and reversibility type B (-.25). Only a very small positive correlation was found with the Conservation factor (.19). As a result of its extremely high coefficient, and low coefficients among other tests, the factor has been named Logical inclusion. However, it is regarded as such with considerable reservation, since the lack of supporting evidence is obvious.

Discussion

The factors which arose in the analysis of the Piagetian batteries did not entirely fit the expected pattern, however they are in line with many of Inhelder and Piaget's postulates. There is evidence of a general ability in loadings on the first unrotated factor, which had its strongest weightings on the Piaget-Inhelder flexibility of hindsight and foresight tasks. This lent support to their position which suggested that such flexibility was essential for the development of operational schemata, and would consequently appear as a mechanism in most tasks requiring concrete and formal operations.[18]

Of more interest at this point however, are the results of the oblique rotations. Higher correlations were expected between the factors than were actually obtained. Little relationship was found between Reversibility as Inversion in classes and Reversibility as Reciprocity in relations. This seems very likely to be a result of the age of the children in the study. Flavell has pointed out that:

> to be found in the concrete-operational groupings—negation or inversion, indigenous to the class groupings, and reciprocity, found in the relation groupings—does not possess a total system which permits him to coordinate the two and thereby solve multivariable problems which require this kind of coordination. Just as the various content areas resist a single, once-for-all structuring by the concrete-operational child, so his various cognitive structures—adequate though they may be in their own separate dominions—fail to combine into the unified whole necessary to manage certain complex tasks.[19]

Labelling of the first factor as Reversibility A was in accord with Inhelder and Piaget's[20] view of the nature of the structure underlying the development of reversible operations, but it was felt that the tasks were requiring flexibility abilities very similar to those suggested by Torrance[21] and Guilford[22] as basic to the production of creative solutions to problems.

The second factor obtained from the Piaget battery was named Reversibility B because it seemed to represent the operation of reversibility in spatial relationships. Inhelder and Piaget in writing of the development of points and continuity in topological space state that:

> . . . the process of reducing what is regarded as continuous to a series of adjoining points and recreating an operational continuity on the basis of these points, a process thereby identified as one of *reversible combination,* is the most advanced type of the operations involved in separating enclosed parts.[23]

When a problem involving the visualization of an object or design in a different position or from a different perspective occurs, Inhelder and Piaget propose that its solution arises out of the child's transition from egocentric realism to relational co-ordination. The latter involves the *operational* co-ordination of view points, and it is characterized by reversibility.[24]

Flavell points out that Piaget is really concerned with *representation* of space rather than perception, and the tasks which show high coefficients on Factor II require the representation of changed spatial relationships. Piaget, according to Flavell, is "almost obsessional" in his insistence that spatial representations are built up through the organization of actions into operational systems rather than direct perception of "obvious" relations.[25] Piaget states that:

> . . . concerning space, in particular, it is obvious that every motor totality tends to form a "group" whose elements are defined *precisely* by reciprocity.[26]

Earlier he had suggested that:

> It is precisely because he fails to grasp the *reciprocity* existing between different points of view that the child is unable to handle relations properly.[27]

The results of the present study are consistent with Piaget's position on the dual nature of reversibility in concrete operations.

Those tasks requiring the organization of relationships (the spatial visualization tasks) have tended to correlate on Factor II while those tasks having to do with inclusion of classes (the flexibility tasks) have correlated on Factor I.

This is consistent with the effect of the ages of the sample and it is possible that the two factors would correlate were the age range widened to include boys from the early concrete operational stage to the early propositional stage.

It appears that flexibility of hindsight and foresight as measured by the author's interpretation of Inhelder and Piaget's clinical method, and the space relationship-orientation tasks of Vernon's and Towler's interpretation, are related to the two types of reversibility but not to each other within the sample under study.

The low coefficients of the conservation tasks on the first two factors may also be attributable to the narrow age range. It had been expected that they would appear on both types of reversibility but it is pointed out that each subtest of conservation in Vernon's battery is at some different point in Piaget's continuum of development. Hence the effect of reversibility in specific conservation tasks may have been clouded. Two of the four conservation tasks did show coefficients above .3 and another (Conservation of Area) reach .18 on Reversibility A. Again, it is suggested that a sample from grades I through X might produce a different factoral structure so that conservation and both forms of reversibility were more closely linked. In this study however it seems clear that there is a conservation factor not closely associated with either type of reversibility.

REFERENCES

[1] J. Piaget, *Les Mécanismes Perceptifs: Modèles Probabilistes, Analyse Génétique, Relations avec l'Intelligence,* (Paris: Presse University, 1961).

[2] D. E. Berlyne, "Recent Developments in Piaget's Work," *British Journal of Educational Psychology,* Vol. XXVII, 1957, pp. 1-12.

[3] *Loc. cit.*

[4] D. E. Berlyne, *op. cit.,* pp. 1-12.

[5] *Loc. cit.*

[6] B. Inhelder and J. Piaget, *The Early Growth of Logic in the Child,* (London: Routledge and Kegan Paul, 1964).

[7] B. Inhelder and J. Piaget, *Ibid.*

[8] B. R. Blishen, "The Construction and Use of an Occupational Class Scale," *Canadian Journal of Economic and Political Science,* Vol. XXIV, 1958, pp. 519-531.

[9] P. E. Vernon, "Environmental Handicaps and Intellectual Development," *British Journal of Educational Psychology,* Vol. XXXV, 1965, pp. 9-20.

[10] J. O. Towler, "Children's Spatial Concepts," Unpublished Master's Thesis, The University of Alberta (1965).

[11] K. G. O'Bryan, "Reversibility, Intelligence and Creativity in Nine-year-old Boys," Unpublished Master's Thesis, The University of Alberta (1967).

[12] B. Inhelder and J. Piaget, *loc. cit.*

[13] J. Piaget, *Logic and Psychology,* (New York: Basic Books, 1957), p. 28.
and Kegal Paul, 1963).

[14] B. Ihnelder and J. Piaget, *The Child's Conception of Space,* (London: Routledge

[15] *Ibid,* p. 207.

[16] *Ibid.*

[17] P. E. Vernon, *op cit.*, pp. 9-20.

[18] B. Inhelder and J. Piaget, *loc. cit.*

[19] J. H. Flavell, *The Developmental Psychology of Jean Piaget,* (New York: D. Van Nostrand Co. Inc., 1963), p. 204.

[20] B. Inhelder and J. Piaget, "The Early Growth of Logic in the Child," *loc. cit.*

[21] E. P. Torrance, *Education and the Creative Potential,* (Minneapolis: University of Minnesota Press, 1963).

[22] J. P. Guilford, "Traits of Creativity" in *Creativity and Its Cultivation,* (Ed.) H. H. Anderson, (New York: Harper and Row, 1959).

[23] B. Inhelder and J. Piaget, "The Child's Conception of Space," *loc. cit.*

[24] J. Piaget, *"Les Mécanismes Perceptifs: Modéles Probabilistes, Analyse Génètique, Relations avec l'Intelligence,"* (Paris Presse University, 1961).

[25] J. H. Flavell, *op. cit.*, p. 328.

[26] J. Piaget, *op. cit.*, p. 274.

[27] J. Piaget, *Judgment and Reasoning in the Child,* (New York: Harcourt and Brace, 1928), p. 134.

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This article reports a replication of Piaget's experiment on understanding between children with a slight change in experimental design and with control of sex differences. The results of the replication were in close agreement, both quantitatively and qualitatively, with Piaget's findings. Sex differences were not significant.

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Understanding Between Children of the Same Age

In the forty years since Piaget wrote *The Language and Thought of the Child*, his theories concerning the functions of children's language have been re-examined a number of times. His conclusion — that the child's speech prior to age seven is essentially egocentric verbalization of thought with little concern for, or appreciation of, the listener whereas after that age it becomes increasingly socialized with definite communicative purpose — was based on the classification of children's spontaneous speech: it has been challenged by the results of the categorization of American children's speech by "egocentric" or "socialized" dimensions.[1] But Piaget conducted further experiments with the purpose of amplifying and offering more proof of the theory that the child's language reflects his type of intellectual orientation and structure. One of these experiments which is seldom cited and which, as far as is known, has not been replicated, studies the effect of the stage of language development on communication between children.[2]

The problem is stated generally by Piaget: "when children talk together, do they understand each other?"[3] He then hypothesizes more specifically that the young child, because of his ego-centricism, is shut up in his own point of view whether he is trying to explain his own thoughts or understand those of others. Thus he (a) will not communicate certain types of verbal material to another child through inability to adapt to the listener's needs, and (b) will believe that he has understood a speaker when in fact he may not have done so.

Piaget's Experiment

Two experiments were really carried out simultaneously by Piaget. He investigated understanding between children during an exchange of stories and also during an exchange of explanations about a diagram of a mechanical object: a tap, a syringe, and a bicycle were used. In the present study only understanding of stories was investigated since Piaget gave separate results according to the types of material used and believed that the presence of the diagram during explanations and the interest of the child in mechanical matters introduced different variables into the communication situation. Accordingly, only the experiment with "stories" will be described.

Piaget used 50 subjects: 30, all boys, were between the ages of seven and eight, and the ages of the other 20 were between six and seven. Eight of the latter group were girls although Piaget does state that he considers it unwise to mix the sexes in this type of enquiry. The subjects in each group were arranged in 15 and 10 pairs respectively. It is not known whether the pairs in the smaller group were all of the same sex.

The subjects worked with the experimenter one pair at a time. He first spoke to the two subjects together saying that they were going to tell stories and that one subject (called by Piaget the reproducer) would go out of the room while the experimenter told the other (or the explainer), a story. The explainer was required to listen very carefully as the story was told, and then the reproducer would return and hear the same story told, this time, by the explainer.

The reproducer then left the room and one of three set stories was read to the explainer. The experimenter tried to give the impression of not reading the story but rather telling it "in the most natural manner possible".[4] The more complicated passages were repeated and everything done to make the subject listen, but the text was not altered".[5] The reproducer then returned and the explainer told him the story, the explainer's story being recorded *in extenso.* The reproducer then retold the story, his retelling also being recorded *in extenso.* Finally, to ascertain whether or not omissions were due to faulty listening comprehension, the explainer and the reproducer were again separated and first the reproducer and then the explainer were asked questions on points that had been omitted in their stories (as shown by the *in extenso* record). The time interval between being told the story and being tested for comprehension was thus systematically longer for the explainer than for the reproducer.

Two subjects then exchanged roles and the experiment was repeated with the same pair but this time a different story was used. It is not known in what order and how often each of the three stories was used.

The stories were "parcelled out" into main points and the retold stories measured by the number of story points they contained, the order of presentation of points being disregarded. Any further points answered correctly during the comprehension questioning at the end of each experiment were counted for each subject. Using the "story points" plus any additional "comprehension points" of both reproducer and explainer—RSC and ESC—the following four ratios were computed:

$$\alpha = \frac{\text{RSC}}{\text{ESC}}$$ (Total comprehension of the reproducer in relation to total comprehension of the explainer.)

$$\beta = \frac{\text{RSC}}{\text{ES}}$$ (Total comprehension of the reproducer in relation to story points expressed by the explainer.)

$$\gamma = \frac{\text{ESC}}{\text{Max points}}$$ (Total comprehension of the explainer in relation to the original story.)

$$\delta = \frac{\text{ES}}{\text{ESC}}$$ (Story points expressed by the explainer in relation to total comprehension of the explainer.)

Piaget computed the ratios for each subject in each of his two roles and calculated four mean ratios at each age level (Table III).

The Replication

Piaget's design, using one pair of subjects for two experiments with alternation of roles, was modified slightly. To try to control to some degree the learning and interaction between pairs of subjects which might affect the results of the second experiment, each experiment was carried out with a different pair of subjects. After the first experiment, the reproducer (B) then became the explainer for a different reproducer (the third subject, C) who in turn became explainer for a fourth subject, D. Thus, each subject, although playing the role of both explainer and reproducer as in Piaget's experiment, had a different partner each time. The results of the first and last subjects, explainer and reproducer respectively, were not used (Table I). The replication design had the disadvantage of causing each explainer to be experienced when he came to his task, whereas for each reproducer the situation was always novel. However, this effect was constant for each pair of subjects while the extraneous variables introduced into Piaget's design changed from experiment to experiment.

After discussion with grade one teachers it was considered that the story *Epaminondas* might be known by some of the subjects and so only the two "fairy stories" of *Niobe* and *The Four Swans* were used in the replication. These stories differed in length, *The Four Swans*

being nearly twice as long as *Niobe* and containing fourteen points compared to twelve in *Niobe*. These two stories were used alternately in a balanced design so that after a subject was reproducer for one of the stories he then became explainer for the other. Each story was used the same number of times for each of the two roles.

TABLE I

DESIGN OF THE STUDY

Story	Subjects	
	Explainer	Reproducer
Niobe	A	B
The Four Swans	B	C
Niobe	C	D
The Four Swans	D	E
.	.	.
.	.	.
.	.	.
Niobe	M	N
N =	12 (A rejected)	12 (N rejected)

In the replication, the time taken by the subjects to tell the stories was measured because it was thought that it would be interesting to see whether there was a relation between the time spent in story-telling and number of points expressed.

Procedure

The experimenter brought the first two subjects to the testing room and, using Piaget's words, explained to both subjects what they would be required to do. The reproducer was then taken to a waiting area outside the testing room where there were puzzles and drawing materials. The experimenter read the story to the explainer trying to follow Piaget's injunction to read naturally and effectively and trying to give the appearance of telling rather than reading the story. After the story had been told once to the explainer he was asked whether he thought that he knew it well enough to tell it to the reproducer. If he seemed doubtful he was asked whether he would like to hear it again. The story was retold until the subject assured the experimenter that he knew it well enough to tell the reproducers. No subject required more than one repetition.

The reproducer was then called into the testing room and the explainer told him the story. A tape recorder was used to record the story *in extenso* and a stop watch used to time the story-telling. Scoring sheets listing the parcelled out points of each story[6] were prepared for each experiment. As the explainer told the story the points that he gave were checked on the sheet. The story was immediately retold by

the reproducer in the presence of the explainer and was also recorded, timed, and scored for points.

The understanding of each subject was then tested. The explainer first returned to the waiting area while the reproducer was asked prepared, standard comprehension questions pertaining to those points in the story told to him by the explainer but omitted in his own retelling of the story. The reproducer's comprehension answers were recorded on the same sheet as the story points. The explainer then returned and the reproducer went outside while the explainer was asked prepared, standard questions on any points he had omitted from his story-telling. His answers were also recorded on the score sheet.

The explainer was then taken back to the classroom and a new subject brought for testing. The previous reproducer became the explainer and the new subject became the reproducer. The new subject and the explainer both came into the testing room while the experimenter described the tasks to them.

Subjects

Although Piaget interpreted his results to show that between the ages of seven and eight children start to try to be more objective and that verbal understanding begins at approximately this time, the main justification for this conclusion was that the ratios for the younger age group were lower (Table III). The purpose of the replication was to determine whether ratios of understanding similar to Piaget's would be obtained rather than to trace the changes in the ratios with increase in age. Chronological age was therefore not used as an independent variable and the experiment was carried out at the lower age level.

Piaget found no sex differences but states that this was probably because of the small number of girls, implying that sex is an important variable. Accordingly, in the replication the sex differences were controlled.

Fourteen girls and 14 boys were chosen randomly from the grade one population (N = 113) of a Calgary public school in a new housing subdivision close to the university. The socio-economic background of this population has been described as ranging "from artisan up to professional with a definite weighting in the middle class".[7]

Children repeating grade one were excluded prior to sampling so that the age range of the subjects in January 1966, when the experiment was performed, was between six years one month and six years eleven months. Within the two groups, the 14 subjects all of the same sex were then randomly assigned the letters A to N and arranged in the design paradigm.

One pair of identical boys were also tested because it was thought that they might show a different pattern of verbal understanding com-

pared to unrelated singletons.[8] The twins were not included in the sample.

Results

Story points and story points plus comprehension points were scored for both explainer and reproducer for each of the 24 experiments. The four ratios of Piaget were then calculated for each experiment and mean ratios obtained. The harmonic mean, appropriate for ratios, was not used became two of the ratios (β and γ) could be considered to be proportions: furthermore, Piaget gives no indication that he used other than an arithmetic mean. The four mean ratios for the male and female subjects and for the total sample are given in Table II. Table III gives Piaget's results for his two age groups.

TABLE II

MEAN RATIOS FOR MALE AND FEMALE SUBJECTS AND TOTAL SAMPLE

Group	Mean Ratios			
	α	β	γ	δ
Male	0.38	0.60	0.74	0.72
Female	0.52	0.67	0.82	0.81
Total	0.45	0.63	0.78	0.76

TABLE III

PIAGET'S MEAN RATIOS FOR TWO AGE GROUPS

Age in Years	Mean Ratios			
	α	β	γ	δ
6-7	0.48	0.61	0.70	0.87
7-8	0.54	0.64	0.82	0.95

The scores of the Detroit First Grade Intelligence Test[9] were available for all subjects. (The mean IQ on this test for Calgary children is 112.) For the male subjects of the experiment the mean IQ was 118.2 with $s = 11.4$ and for the female subjects 120.5 with $s = 12.8$: a t-test showed no significant difference between the male and female means. The mean CA for both male and female subject was six years seven months.

The non parametric *Median Sign Test* was used to compare the ratios for male and female subjects. None of the χ^2s was significant and the null hypotheses that the samples came from populations with the same medians were accepted for each ratio.

Since two stories were used, the mean ratios for the different stories were also calculated (Table IV). The *Median Sign Test* showed no significant differences between the two stories for the four ratios.

TABLE IV

MEAN RATIOS FOR THE TWO DIFFERENT STORIES

Story	Mean Ratios			
	α	β	γ	δ
Niobe	0.44	0.59	0.79	0.81
The Four Swans	0.46	0.67	0.77	0.71

A Pearson product-moment correlation coefficient was calculated for: (a) the story points expressed by the explainer (ES) and time taken by the explainer to tell the story and (b) for the story points expressed by the reproducer (RS) and the time taken by the reproducer to retell the story. The correlation coefficients are:

	ES	RS
Time	–0.13	0.16

Neither coefficient was significant and therefore the null hypothesis of no relationship between the variables was accepted.

Discussion

A comparison of the four total mean ratios of the replication (Table II) and of Piaget's ratios for the six to seven age group (Table III) shows that they are in fairly close agreement. The discrepancy for δ may be due to the greater difficulty experienced in retelling *The Four Swans* (Table IV), which was used for half the replication tests but presumably for only a third of Piaget's tests. In the replication also, the explainers may have been less relaxed in the experimental situation and may have expressed themselves less freely since the experimenter was a stranger to them: Piaget was probably known to his subjects.

Comparison of the male and female ratios for the replication shows that although the medians are not significantly different, the ratios of the female subjects are all higher than those of the male subjects. This result is in agreement with the tendency, reported by other investigators,[10, 11] for girls to show superiority in language development. The lower δ and α ratios for the boys, compared to Piaget's ratios for his predominantly male subjects, may have been due to the slightly lower chronological age of the Calgary sample. This could have lowered the boys' results although the higher level of language development of the girls brought the total mean ratios close to those of Piaget.

The mean ratios for the two stories for the twin boys were: $\alpha = 0.84$, $\beta = 0.87$, $\gamma = 0.98$, $\delta = 0.96$. Since δ is almost unity, the explainer tried to tell his twin all the story and what he told was well comprehended. The α ratio, while still lower than the other ratios, is much higher than for the other subjects showing that communication between this pair of twins was very effective.

Per contra, Piaget concluded from his numerical results, that before the age of eight the general effectiveness of communication between two subjects (α) is quite poor although the explainer understands the experimenter well (γ) and the explainer reproduces many of the main points of the story (δ). It is β, or the "understanding of the reproducer which is at fault".[12] The reasons for this lack of understanding lie within both explainer and reproducer.

The explainer, being still at the stage of predominantly egocentric speech, simply verbalizes his on-going cognition when called upon to communicate. He fails to orient himself to the listener and tells the story in an elliptical and fragmentary way with poor order, no pronoun antecedents and no causal explanations of events although he may understand the relationships between them. Piaget thus concludes that his hypothesis (a) is substantiated.

The listener does not bother to pay very close attention. He is confident that he has understood and when he is unable to repeat the story he will make up a different story or distort what he has heard in favour of his previously formed conceptions. The child is unconcerned about objectivity because he is not yet at the stage of socialized speech and has no desire to communicate: hypothesis (b) is therefore also supported.

Analysis of the tapes from the replication supports many of Piaget's observations. Evidence of the ego-centricism of the explainer was shown by rather incoherent presentation of the material with careless use of pronouns and very uneven rate of speech. The explainer also tended to speak to himself or to the experimenter rather than to the reproducer. However, there was little fabrication and, in general, the points of the story were given in the correct order with the relationship of the events explained. While all the explainers listened carefully to the experimenter, the reproducers varied in their attentiveness. Some behaved as Piaget described but others listened carefully to the explainer and seemed worried and confused when they could not properly comprehend the story.

In conclusion, three factors affecting explainer and reproducer differentially should perhaps be considered. Firstly, the explainer was told the passage until he declared himself ready to retell it. Some or all of the story was repeated if necessary: in the replication all but

three of the subjects asked that the story be re-read. The reproducer heard the story only once.

Secondly, the explainer listened to an authority figure tell the story and grade one children have learned to pay attention to an authority figure, especially in the school situation. The reproducer listened to a peer.

Thirdly, the experimenter, following Piaget's procedure, tried to read with rhetorical effect in order to hold the explainer's interest and attention. The explainer did not do so.

Thus the poor communication between children during story-telling may have been due to the ego-centricism of the speaker and listener but it may also have been due in part to factors present in the experimenter-explainer situation and not in the explainer-reproducer situation.

REFERENCES

[1] Dorothea McCarthy, "Language Development in Children", in L. Carmichael (Ed.), *Manual of Child Psychology,* (New York: John Wiley & Sons, 1954), pp. 532-542.

[2] J. Piaget, *The Language and Thought of the Child,* (London: Routledge & Kegan Paul, (3rd ed.), 1959), Ch. III.

[3] *Ibid.*, p. 76.

[4] *Ibid.*, p. 85.

[5] *Ibid.*, p. 80.

[6] *Ibid.*, p. 87.

[7] Mary H. Neville and B. P. Frost, "Differential Achievement in Reading and Arithmetic", *Alberta Journal of Educational Research,* Vol. X, No. 4, 1964 p. 194.

[8] E. J. Day, "The Development of Language in Twins: I. A Comparison of Twins and Single Children", *Child Development,* Vol. III, 1932, pp. 179-199.

[9] A. M. Engle and H. T. Baker, *Detroit Beginning First Grade Intelligence Test,* (New York: World Book Co., 1937).

[10] Mildred C. Templin, *Certain Language Skills in Children,* (Minneapolis: University of Minnesota Press, 1957).

[11] McCarthy, *op. cit.*, pp. 551-555.

[12] Piaget, *op. cit.*, p. 95.

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This paper is an attempt to discuss the dualistic nature of Jean Piaget's psychology. Since "dualism" can be interpreted in a multitude of ways, this paper confines itself to a two-fold purpose. Section I deals with the philosophico-psychological dualism inherent throughout Piaget's writings; while in Section II the philosophical and logical status of the theory Piaget purports is considered. From this it can be inferred that the four stages of concept development postulated by Piaget are related to the logical levels of language that have been postulated by scientific philosophers such as Rudolf Carnap.

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The Psychological Theory of Jean Piaget: Some Philosophical Remarks

I: Philosophico-Psychological Dualism

Incorporated within all Piaget's work is one basic, underlying, philosophical preoccupation. This preoccupation concerns the problem of genetic epistomology; that is, how the "knower" comes to "know" and what mechanisms exist that are found to be inherent in this process. Thus, it follows, that Piaget's main interests fall within the area of cognition and are particularly concerned with the development of intellectual structures. The approach used by Piaget to reveal the development of these intellectual structures is ontogenetic in nature. That is, Piaget studies overt behaviour in order to infer the psychological mechanisms influencing the evolution of the "knower-known" relationship. It is this "knower-known" relationship which gives rise to the existence of intellectual structures.

Intellectual structures function in Piaget's system as connections between the philosophically rooted "functional invariants" (that is, assimi-

lation and accommodation) and the psychologically rooted behavioural "contents". Because behavioural contents are constantly evolving, structures are continually becoming more sophisticated. Piaget accounts for this by what he terms the "continuity principle"; interpreted in this context to mean, that structures change as a result of the action on the part of the individual or his or her environment. The assumption being that it is the disequilibrium produced by evolving structures that motivates the individual on through 'ontogenesis'. This process is continuous and involves the continual differentiation, integration, and reorganization of existing schemas into new schemas.[1] The emphasis, in this dualistic approach, is on the determination of how intellectual structures evolve, not on control, acceleration, or retardation of intellectual behaviour.

Dynamically, Piaget asserts that intelligence is a process of assimilatory and accommodatory structures reaching an equilibrium. It follows then, that since equilibrium is reached through the constant, complementary functions of assimilation and accommodation, these constant functions can be used to study the structures of developing intellect. Therefore, Piaget proceeds, experimentally to reveal these structures via a zoological type of classification of behavioural contents (from which structures can be inferred) to develop a progression of developmental stages. This type of classification forms the biologically oriented part of the system which is juxtapositioned by the philosophically oriented concepts mentioned previously.

Within each stage, the functional invariants come to form a type of incomplete equilibrium, characterized by the interdependence of all structures within that stage to form an integrated whole. (Complete equilibrium is not reached until "Formal Operations".) Piaget's experimentation has largely involved an attempt to identify these "wholes" and seems, to the writer, to logically presuppose their existence. Or, in other words, to attempt to "describe" stages of development of intellectual structures by "prescribing" that within a given stage these structures form an "integrated whole", and then set out to determine these "wholes" is logically inconsistent.

Philosophically, Piaget's developmental concepts can be interpreted in the light of Hegel's doctrine of thesis: antithesis: synthesis, claimed to characterize logical-thought-processes. It is the suggestion of the writer that perhaps Piaget was influenced enough by this doctrine to endeavour to make an attempt to determine if the pattern of ontogenesis followed a similar type of organization. For example the two dynamically opposed, but complementary processes of assimilation and accommodation can be viewed as the thesis and antithesis parts of the Hegelian triad, which eventually are synthesized resulting in adaptation of the individual. Another example is found in the formation of the

concept of reversibility which is an essential pre-requisite to the evolution of formal operations. Contained within the concept of reversibility are two sub-concepts both of which must be attained in order to form complete reversibility. These two sub-concepts are: (1) *Inversion or Negation* which applies to classificatory operations where one operation is cancelled by a corresponding negative thought operation and (2) *Reciprocity* which applies to operations involving relations.[3] The writer has interprted these sub-concepts as the thesis, antihesis portions of the triad. Thus, it follows that when synthesis occurs between the two reversibility at a formal operations level is the result. Lastly, the period of formal operations itself could be an exemplar of the aforementioned philosophical position. To quote Piaget "Instead of just co-ordinating facts about the actual world, hypothetico-deductive reasoning draws out the implications of possible statements and thus gives rise to a unique synthesis of the possible and the necessary. That is, the subject's logic is now concerned with propositions as well as objects."[4]

Therefore, it could be concluded that Piaget has used a Hegelian philosophical orientation as an analytical technique to facilitate interpretation of his experimental data. This lends further support to the writer's beginning assertion — that there is a philosophico-psychological methodological dualism inherent throughout Piaget's psychology.

Piaget's method of acquiring empirical data has been criticised and questioned particularly in the United States but is now gaining greater acceptance and support.* Piaget argues that a "clinical methodological technique" is necessary and the only effective way of handling the kind of problems he studies. He contends that the "skill and ingenuity of the examiner must in part compensate for the inherent deficiencies in the clinical method itself".[5] However, philosophically, this kind of an experimental methodology seems to assume that "mind" (or intellectual structures) can be inferred from overt action ("body"); an assumption which raises the question: Is there a logical relationship in this type of inference and, if there is, what is it? According to G.E. Moore, to make this type of inference is to commit an error he termed the "naturalistic fallacy". An error within this category involves making the logical error of supposing that the "is" of a particular fact can imply the "ought". In other words, to say that the existence ("is") of a certain behaviour can lead one to imply what intellectual structures are present is a logical error.

II: Philosophical and Logical Status of Piaget's Theory

Scientifically oriented philosophers such as Rudolf Carnap and a host of others too numerous to mention have devoted much effort to the

*See Egon Mermelstein, "A note on Piaget's clinical method of questioning", This issue, pp. 181-184.

study of concepts and concept development. Their work involves, among many other things, a study of the logical characteristics of the languages in which concepts of different degrees of abstraction and generality are expressed. In an attempt to clarify the relationship between theoretical terms used to express theoretical concepts and ontologically existent states of affairs Carnap presented the distinction between *observation* and *theoretical* languages as the extremes of a continuum the intervening stages of which are occupied by *extended observation* languages.

In an attempt to develop a model for the analysis and clarification of the concepts associated with programmatic and cliché terms in educational research and theory development Eastwood[7] modified Carnap's thesis and produced the following general systematic categorization.

Type of Concept	*Designating Symbol*	*Type of Language*
Observable entities	α_o	L_o
Simple generalization	α_s	L_{es}
Conjectural generalizations (abstractions)	α_c	L_{ec}
Theoretical constructs	α_t	L_t

Eastwood contends that terms such as 'experience' which occur profusely in educational and psychological discourse may and do refer to particular observable states of affiars (α_o), simple generalizations about particular observables (α_s), abstractions or conjectures (he prefers the latter word) from observation states (α_c) or purely theoretical concepts (α_t). He further asserts that the failure of the language currently in use in these domains of discourse, to distinguish these contributes significantly and seriously to conceptual confusion and leads to methodological muddles in both research and theory formation. The solution to this problem necessitates the application of a set of procedural rules and he suggests that the following might be appropriate and adequate.

1. Any discussion and hence any attempt at theory formation based on particular observable data (the α_o level) must be expressed in an L_o. Such theories are pseudo-scientific and, more importantly, are predominant in educational discourse.

2. The introduction of generalizations from a finite set of particular observations raises the α_o to the α_s level and moves the discourse from an L_o to an L_{es}. But, and here is the rub, the status of these generalizations (α_s concepts) is neither epistemologically nor ontologically different from α_o. It follows that any attempt to produce a theory the primitive terms of which refer to α_s concepts is systematically misleading. Most decisions based upon the experiences of the formulator are of this type.

Any generalization which is formed at this level is a generalization of observables. That is, the examplar of the generalization should be a

particular. A one-to-one relation between generalization and observable is held thus making the relation at this level testible in terms of a particular (s).

One can be concerned, at this level, with descriptive theories. From a theory developed at this level prediction is not valid since prediction necessitates the development of "laws" and one cannot establish laws at this level. The only prediction possible at the α_s level is prediction based on inductive inference. That is prediction which is centred from particular instance to particular instance.

3. The symbol α_s designates a *class* but the conjectural generalization designated by α_c refers to a *concept* associated with the class. (there may be more than one concept associated with a class at the conjectural-abstraction level.) The relationships between a concept (α_c) and instances of a class may be operationally or stipulatively defined.

4. At the α_c level there are two senses in which abstractions can be formulated. These are:

(a) *Intuitive* — refers to what is directly apprehended from an inductive approach. The emphasis here being on impartiality. However, intuitive generalizations seldom occur without certain idiosyncratic presuppositions. One also must face the danger of drawing conclusions from insufficient evidence. This danger can be further increased if maintenance of the logical separation between the concept and individual is not maintained.

(b) *Universal* — exemplification of some universal principle. Because one is looking for exemplifications of a "held" concept, the emphasis is on confirming evidence and the universal principle may be unwittingly modified to account for disconfirming instances.

It could be stated that "Intuitive conjectural generalizations" differ from "Universal conjectural generalizations" in that the latter are obstensively learned. Because they are learned in an ostensive manner, there is a tendency to emphasize attitudes. For example, attitudes toward a "held" concept can determine whether the emphasis is placed on confirming or disconfirming evidence.

5. At the α_t level the concern is with theoretical terms and may have no direct observational links with observables. That is, at this level, the descriptive or non-logical terms may refer to unobservable facts or entities. In other words the formation of α_t concepts is logically but not empirically (i.e., observationally) necessarily related to or dependent upon any known particular states. These concepts are logical constructions of possible states.

It seems to the writer, that Piaget looks at observables (overt behaviour) which function at the α_o level, and by a method of simple generalization develops a zoological type of classification of the stages in

cognitive growth (α_s level); therefore, if one holds the system of language functioning as purported above, it is not logically consistent to infer from a simple generalization any abstractions at a theoretical level, or in Piagetian terms to infer abstractions about the nature of intelligence.

J. T. Wohlwill makes this point, in part, when he says that "horizontal decolage is not fully assimilated throughout Piaget's system." According to Wohlwill, "assimilation of this type, will require a less uncompromisingly deterministic and absolutist conception of mental operations or at least of their overt manifestations than Piaget has presented . . . and creates a need for methodological models which include a greater tolerance for error and variability . . ." Wohwill's article suggests that there is need for additional research on "functionally necessary sequential dependencies"[8] in order to develop a firm theoretical foundation for the concept of "horizontal decolage".

The emphasis in Piagetian theory is on explanation through description at the L_o and L_e levels of language. The terms derived to show the evolution of intelligence in the child function as theoretical concepts. That is, terms such as "reversibility", "schema", "preconcept", or "egocentrism" tend to be very broadly defined conjectural abstractions (α_c) and have no theoretical (α_t) counterpart. In other words, the concepts mentioned are not part of what is generally referred to as a "descriptive explanatory theory".[9] This type of theory does not start with a statement which contains within it epistomological or metaphysical assumptions. Rather the theory ensues from observations or examination of a situation and follows the general format below:

> Descriptive explanatory theories start with a set of "primitive" terms which are linked by "co-ordinating definitions" to observational statements. From this is derived a set of "defined terms" specific for the theory within which they operate. From the "defined terms" a set of "axioms" are derived. The "axioms" lead to the derivation of a set of testible hypotheses from which, upon subjection to rigorous testing, can be derived a set of "law-like" statements which enable risky, but scientifically useful, predictions.

It is the contention of the writer, that Piagetian concepts do not function in this type of theoretical system. They are in fact, really conjectural abstractions and thus susceptible to the weakness of this level of language functioning. They are not, in other words, incorporated within an implicitly defined theoretical construct.

There is a need at the conjectural level of language to keep open all channels that facilitate revision of a conclusion. One of the weaknesses (which it could be argued Piaget has fallen victim to) is the temptation to draw conclusions from insufficient evidence. An example possibly illustrating this fact, is the thesis put forth by Piaget that the child proceeds from autism, to egocentrism, to realism (or socialized speech)

in the course of verbal development.[10] On the other hand, Vygotsky claims that egocentric speech does not disappear in the child at the age of six to seven years, as Piaget says, but rather becomes internalized to become inner speech which is to be distinguished from socialized speech. According to Vygotsky, "the decreasing vocalization of egocentric speech denotes a developing abstraction from sound",[11] and the child no longer has to "think words" through pronunciation of words.

This dichotomy suggests two conclusions to the writer:

(1) Vygotsky never defines exactly what he means when he uses the term "egocentric speech", but assumes that what he means by this concept is in fact the same thing Piaget means when he uses the term "egocentrism" in reference to speech.

(2) Neither Piaget nor Vygotsky relate the concept of "egocentrism" to an implicitly defined theoretical construct. Also, they do not derive their conclusions from extensive empirical data, suggesting an hypothesis emphasizing the necessity of more extensive research, oriented within a descriptive explanatory theoretical system, in order to determine a more empirically verifiable concept of "egocentrism".

Some would argue that Piaget has given "intelligence" the aforementioned type of theoretical status. But, in the writer's view, what Piaget has done is inferred from overt behaviour that intelligence is not an entity but a "process", and a "product" which can be equated to the complementary processes of assimilation and accommodation to result in adaption of the individual. What Piaget claims to be "intelligence" may in fact be true, but an attempt must be made to place it at the level of a descriptive-explanatory theory in order to subject Piaget's notions of this construct to a rigorous, corroborative test.

Piaget's attempt to develop a theoretical basis for the concepts he explains as characteristic of the development of the "knower-known" relationship appear to fall more into the realm of a philosophical as contrasted to a scientific theory. (The former is concerned with the kind of theory which is based on some kind of metaphysical assumption.) It is philosophical in the sense that Piaget makes the following assumption: "Since philosophical interpretations leave its internal techniques (logic) unchanged shows that the latter has reached the axiomatic level; symbolic logic, thus constitutes if for no other reason, an ideal 'model' of thought".[12] Although Piaget does give a "mathematical-logical" expression to (α) concepts whenever possible, it does not seem sufficient to base the justification of the mathematical expression on the assumption that "symbolic logic" is an ideal "model" of thought.

Conclusion

Although Piaget says that intelligence is composed of constant function (that is, assimilation and accommodation) he does not claim that

intelligence is characterized by constant structures. Intellectual structures are envisaged as constantly changing; but inherent within the perpetual evolution are "outline structures" which are precursors of logcial structures and which can be formulated in terms of the algebra of logic . . ." And, Piaget admits: "It is not inconceivable that a general theory of structures will at some future date be worked out, which will permit the comparative analysis of structures characterizing the different levels of development. This will relate the lower level "outline structures" to logical structures characteristic of higher stages of development."[13] Perhaps then, the theory of language referred to above will be an aid in the development of a firmer theoretical foundation for Piaget's theory.

A firmer theoretical foundation can, in turn, facilitate the transformation of Piagetian notions into teaching practice since the hypotheses formed from the axioms in a descriptive-explanatory theory, are dependent upon a test by an appeal to practice. In other words, the theory does not survive through reliance on epistomological or metaphysical presuppositions, but depends upon application and practice with a continuing opening for correction if the hypotheses are shown to be false. Possibly, this is the level of language to which all psychological theories must strive to attain in order to be as fully useful as possible.

REFERENCES

[1] L. S. Vygotsky, *Thought and Language,* (New York: John Wiley & Sons, Inc., 1962).

[2] R. Clements, "Theory and Education", *Educational Theory,* Vol. XII, No. 2, 1962, pp. 124-79.

[3] J. Piaget, *Logic and Psychology,* (New York: Basic Books, Inc., 1957).

[4] *Ibid.*

[5] J. H. Flavell, *The Developmental Psychology of Jean Piaget,* (Toronto: Van Nostrand, 1963)

[1] R. Carnap, "The Methodological Character of Theoretical Concepts", *Minnesota Studies in Philosophy of Science,* Vol. I, (Minneapolis: University of Minnesota Press, 1956), pp. 38-87.

[7] G. R. Eastwood, "Theoretical Dimensions of 'Achievement' ", *Studies in Philosophy and Education* (Pending).

[8] J. F. Wohwill, "Piaget's System as a Source of Empirical Research", *Merrill-Palmer Quarterly,* Vol. IX, 1963, pp. 253-62.

[9] G. Bergmann, *Philosophy of Science,* (Madison: University of Wisconsin Press, 1957).

[10] cf L. S. Vygotsky, *op cit.*

[11] *Ibid.*

[12] J. Piaget, *Psychology of Intelligence,* (New Jersey: Littlefield, Adams and Co., 1960).

[13] *Logic and Psychology*

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In this article Dr. Gulutsan has attempted to provide an overview and an assessment of the degree to which the works and theories of Piaget are known and accepted by Soviet psychologists and educators. No claim for extensive or complete coverage of the topic is made but interesting comparisons with the reception given to other western psychologists, noteably behaviorists, are made.

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Jean Piaget in Soviet Psychology

What reception has Piaget received from Soviet psychologists? What do they consider to be the positive and negative features of his work? Answers to these questions, based on a sample of Soviet educational and psychological works available in the University of Alberta library, may help the reader to get an additional insight into Piaget not readily available from either his own works or the works of other Western psychologists. The answers, unfortunately, will not permit the reader to gain insight into Piaget's influence on Soviet educational and psychological thought. This limitation of the article must be recognized.

I

Piaget's conceptions have been well received by Soviet psychologists. From the time Piaget's writings first appeared, Soviet psychologists have been attracted by them and have given them careful, though by no means uncritical, attention. Sadovsky and Yudin[1] point out that this is no accident for the basic positions of Soviet psychology and those of Jean Piaget have many common features and provide possibilities for a wide and fruitful collaboration. In the preface to Piaget's first two books translated into Russian in 1932, Vygotsky[2] wrote, "Psychology owes a great deal to Jean Piaget. It is not an exaggeration to say that he revolutionized the study of child language and thought". Galperin[3] stated,

"The comparison of our notions with those of Piaget has great signficance for us for we too start with action as the central problem of psychic life and psychology".

An examination of the titles of articles published in *Voprosy Psikhologii* (Questions of Psychology) from the time it began publication in 1955 to the end of 1966 brings out several interesting facts. Piaget's article[4] on the basic problems of genetic epistemology was the only one in the Journal from a Western contributor prior to 1961. The count at the end of 1966 was as follows: three acticles by Piaget; two from each of Paul Fraisee of France and Karl Pribram of the U.S.A.; and one each from six other contributors.

Articles in *Voprosy Psikhloogii* by Soviet authors on Western psychologists provide another interesting tally. Of the ten special articles which feature Western psychologists that have been published, Antsiferova[5], Komm[6], Lektorsky and Sadovsky[7], Obukhova[8], and Sadovaky and Yudin[9], have written about Piaget and his work. Sadovsky and Yudin dedicated their article to Piaget on the occasion of his seventieth birthday. No attempt was made to count the number of articles which like Galperin's[10] draw heavily on Piaget's work but are not primarily oriented toward it.

Reports on the International Congresses of Psychology submitted by Soviet participants include favourable comments on Piaget. Zaporozheta reports that Piaget's lecture to the 1954 Congress in Montreal, illustrated with expressive and significant examples, merits deep attention. He added, "In contrast with his earlier reports in which he opposed elementary sensory processes and intellectual acts, Piaget now recognizes their mutual relationship".[11] The more recent position, it should be noted, is similar to that held by Soviet psychologists.

Leontiev and Luria[12] reporting on the 1957 Congress at Brussels, referred to Piaget's *brilliant* lecture on why concept formation cannot be explained by perception alone. Lomov[13] commented that Piaget had organized one of the most interesting symposiums on the actual genesis of perception. Zaporozhets'[14] contribution to this symposium was on the training of perception and Piaget emphasized that the position taken by Zaporozhets appeared to be most appropriate.

The XVIII International Congress of Psychology was held in Moscow and was organized by the Soviet Society of Psychologists. Piaget, whose 70th birthday coincided with the Congress, was invited to participate in two symposia and to deliver a special evening lecture on "Psychology, Interdisciplinary Relations and the System of Sciences".[15] The writer had participated in the congress and noted that Soviet psychologists were well acquainted with Piaget's works and were very attentive to Piaget's presentations.

Three of Piaget's books are known to have been published in Russian. *Language and Thought of the Child* and *Judgment and Reasoning in the Child* were published in 1932. The discussion of Piaget's position in these books was by Vygotsky and appears in Chapter 2 of his *Thought and Language.* In 1963, a Russian version of *The Growth of Elementary Logical Structures, Classification and Seriation* was published. In preparation at the time of this article is a collection called *Selected Psychological Works of Jean Piaget* under the editorship of Lektorsky, Sadovsky and Yudin. These editors are members of the section of psychology, institute of philosophy of the Academy of Sciences.

Articles on Piaget's work or which refer extensively to Piaget are also found in educational journals which have a much greater circulation within the USSR. Some examples are El'konin's[16] article in *Preschool Education* on "Symbolics and its Function in the Play of Children", Kohstamm's[17] (from Holland) article in *Soviet Education* on "Teaching Piagetian Thought Operations to Pre-operational Children", and Gonobolin's[18] report to the thrice-weekly *Teachers' Gazetteer* on "Training and Development", based on contributions to the International Congress of Psychology held in Moscow in August of 1966.

The writer conscientiously perused the literature to the end of identifying another Western psychologist whose reception in the Soviet Union might approach that given Piaget. The search was futile. Piaget alone seems to get as much coverage in the Soviet Union as the rest of the Western psychologists taken together.

What do Soviet psychologists consider to be the positive and the negative features of Piaget's thought? In the early thirties Vygotsky, who introduced Piaget to Soviet psychology, identified two valuable contributions. One was the clinical method of exploring children's ideas and the other was the facts he unearthed. By means of the clinical method, Piaget was able to show the ways in which child thought was distinctive and characteristic rather than simply deficient when compared with adult reasoning. Two simple and self-evident ideas characterize Piaget's brilliant discovery. Firstly, the main difference between child and adult thought was qualitative rather than quantitative. Secondly, child thought evolves in accordance with an identifiable developmental direction.

Vygotsky's main issue with Piaget was over the developmental direction of child thought and particularly the role of egocentrism in the developmental process.

> Egocentric speech as a separate linguistic form is the highly important genetic link in the transition from vocal to inner speech, an intermediate stage between the differentiation of the functions of vocal speech and the final transformation of one part of vocal speech into inner speech. It is this transitional role of egocentric speech that lends it such great theo-

> retical interest. The whole conception of speech development differs profoundly. Thus our schema of development—first social, then egocentric, then inner speech—contrasts both with the traditional behaviourist schema—vocal speech, whisper, inner speech—and with Piaget's sequence—from nonverbal autistic thought through egocentric thought and speech to socialized speech and logical thinking. In our conception the true direction of the development of thinking is not from the individual to the socialized, but from the socialized to the individual.[19]

He suggests that Piaget's socialized speech might be better called communicative speech. Then, communicative and egocentric speech would both be seen as forms of inner speech for both require vocal (social) speech as their antecedent stage. Autistic thought, a corollary of realistic thought, results from realistic thought and is, therefore, a late development.

Vygotsky called for a reappraisal of the applicability and generality of Piaget's findings. Piaget was led to believe, on the basis of his experiments, that the child was impervious to experience. Developmental uniformities discovered by Piaget, says Vygotsky, may apply to the given milieu under the directions of study but they are not laws of nature because they are historically and socially determined. Whether a child's speech is more egocentric or social depends not only on his age but on his surroundings. Under frustrating conditions egocentric speech increases. Vygotsky also noted that peculiarities of speech, such as syncretism, are not as extensive in development as Piaget believes and said:

> We are inclined to think (and our experiments bear us out) that the child thinks syncretically in matters in which he has no knowledge or experience but does not resort to syncretism in relation to familiar things or things within easy reach of practical checking—and the number of things depend on the method of education.[20]

The reader should be reminded that Vygotsky died in 1934 and that the criticisms may not be valid for Piaget's more recent works. In the *Comments* prepared for the 1962 English translation of Vygotsky's work, *Thought and Language,* Piaget himself tries to see whether Vygotsky's criticisms seem justified. He answers, "Yes and no; on certain points I find myself more in agreement wiht Vygotsky than I would have been in 1934, while in other points I now believe I have better arguments for answering him".[21]

Komm[22] notes that Piaget's theory of intelligence is based on a significant number of concrete experimental researches having considerable interest because of their richness of factual material, their experimental technique, the clear and systematic presentation, and the theoretical interpretation of results. The general direction of Piaget's research on the large and complex problem of intellect, along with the abundance and diversity of facts make it possible to place a high value on his

works for scientific psychology. Of interest are Piaget's aims to establish a closer relation between logic and psychology and to more exact methods in psychology. For these reasons, in Komm's opinion, Soviet psychologists should take notice of Piaget's attempt to provide logical formulae for the characteristics of the formation of thoughts available to the child at various levels of his development. They should notice his attempt to express various psychological facts in the precise formulae of the algebra of logic.

Komm added the following observations regarding Piaget's position: First, although Piaget's aspirations to study thinking proper are correct and necessary, nevertheless his treatment of thought autonomously from knowledge is unwarranted and artificial. Thought devoid of knowledge does not exist and cannot exist. The actual thought of the child is revealed by how he masters and utilizes knowledge. Second, exception should also be taken to Piaget's treatment of such basic concepts as invariance and reversibility. For Piaget, invariance is the result of reversibility and is the basis of objectivity. The concept is objective because it is invariant. For Komm, reversibility is simply the means by which invariance is realized in the system of a concept and hence serves to re-establish invariance. Objectivity is the basis of invariance and the concept is invariant because it is objective and not the other way around. Invariance is an indicator of objectivity. Piaget, by finding the features of operations in their relations one to the other and external to their relations to the object and to reality, coincides with the philosophical position of operationalsim. In this respect Piaget is not true to himself for he is incomparably more realistic, if not materialistic, than the American relativist, Bridgman. Insofar as Piaget relates the operations one to the other and remains silent on their relation to objective reality, he slips into Bridgman's position. Having given these observations Komm remarks, "We would want to separate Piaget from Bridgman and from all other proponents of operationalism."[23]

Lektorsky and Sadovsky[24] directed their attention primarily to Piaget's work on genetic epistemology. They regard as positive Piaget's aspirations to connect psychological theory of thought to well expressed logical conceptions. The development of the psychology of thought is inseparably connected with the course of research on the logic of thought. Another positive feature is the general direction of Piaget's research on logic and his accompanying aspiration to connect existing logical theory with the analysis of thought processes. The works of Piaget occupy a special place in this area of research and are distinguished by the extent of useful empirical data, consistency in the construction of basic theoretical principles and the possibility of practical application. Piaget's thought on the equilibrium of the system of logical operations merits special notice. Thanks to it, it is possible to connect the formal

theory of the operations of thought (logic) with real mental actions analyzed in psychology.

The critical observations offered by Sadovsky and Lektorsky refer to initial theoretical premises which, they claim condition and limit his theory. Piaget did not perform any radical reconstruction of the logic but merely reformulated and reinterpreted existing logical principles in a bed of different ideas without resolving the controversy that exsits between logic and psychology. He transfers from logic into psychology the norm for thought, namely the equilibrium of intellectual operations and presents this norm as a fact respecting cognitive structure. The authors suggest that as long as logic and psychology remain empirical studies controversies between them will remain unresolved. Piaget's work has to be interpreted in the light of this logically basic shortcoming. Shortcomings in Piaget's general psychological position are to be found in the explanation of the subject-object relations (for which the Soviets have developed the theory of reflection) and on the relation of concept of objective reality.

In the article on Jean Piaget as a psychologist, logician and philosopher prepared in honour of the Swiss psychologist's seventieth birthday, Sadovsky and Yudin[25] reject the reproaches made earlier by Komm that Piaget slips into Bridgman's operationalism. The operational conception of the intellect in its gnoseological features has nothing in common with the philosophy of operationalism even though that conception was fruitful also within the framework of operationalism. The subjective and idealistic interpretations of operationalism are extremely foreign to Piaget. Weaknesses in Piaget's position are to be found in the lack of research on higher forms of cognition, such as scientific cognition and its structure. His analysis of cognition is based on conceptions of actions only and not on activity (i.e., total activity), particularly, the social historical activity of the social subject.

Antsiferova[26] identifies an interesting and, from her view, positive influence of Piaget on Western psychological thought. She noted that anti-positivitic and anti-idealistic tendencies are being sharply strengthened in the West. Spokesmen for neobehaviourism are reconsidering their operational positions. Concepts of thought, ideas, forms, perception and consciousness, formerly repudiated by positivists as the outcome of idealism, are once more becoming popular. The attempt in the West to supplement neobehaviourist theory of thought with several propositions from Piaget's concept of operations has ended in the creation of the framework for anti-behaviourist theory.

Gonobolin[27] contrasted the views of Piaget with those of Soviet psychologists. He noted that on the issue, "Does development depend wholly on training or does training only exploit that which development

yields?", Piaget recognizes development as an internal process, the result of the organism's maturation. Training plays a secondary role and is necessarily wholly supported by the laws of development. This view of the primacy of maturation and the secondary role of training is not subscribed to by Soviet psychologists. It should also be understood that in the opinion of Soviet psychologists many experiments, conducted by the school of Piaget, cannot yield fully objective conclusions because of their artificiality, their isolation from real life and their insufficient attention to social conditions.

The most concise statement of the positive and negative features of Piaget's work is provided in the entry by Tikhomirov in the *Pedagogical Encyclopaedia*. The writer translated the appropriate paragraph as follows:

> The positive features of Piaget's conceptions are (1) the revelation of the role of object action [sensorimotor activity] as the main source for developing intellectual processes, (2) the genetic approach to the investigation of thinking, (3) the description of the stages by which intellectual operations are formed, (4) the demonstration of the complex relation between perception and thought, as well as (5) the connection between cognitive and emotional aspects of the child's mental development. The limitation of Piaget's conception lies in the fact that it was not sufficiently elaborated by him concerning the sources from which the various forms of psychological activity appear. Having conceived the thesis concerning object action as the starting point of mental development, Piaget did not surmount completely the abstract sociologism which converts social intercourse into the spiritual one. He bypasses that most important fact, namely that the initial object actions are realized by the child in conditions of communication with grownups who organize the child's actions in accordance with the socially fixed function of the object, which means that relation of the child to the object is socially determined at the very beginning. Connected with this position is Piaget's underestimation of the role of language in the development of object actions. Without any foundation, Piaget, places instruction in opposition to independent mental development of the child. He underestimates child training through intellectual operations and does not give any direct analysis of the transition from external object actions to internal intellectual actions.[28]

Conclusion

So far as Henry Murray[29] has been able to learn, only Soviet psychologists have performed multivarious, comparable studies in the region of conscious planning, initiation and control of effective muscular and social actions. For this emergent region of psychological study, the work of Jean Piaget on the development of perception and cognition has distinct relevance because for Soviet psychologists, as well as for Piaget, actions are the central problem of psychological life and of psychology. The origins and development of these actions form the core of research conducted by Soviet psychologists in the Vygotsky tradition. It is not

an accident that they have shown an interest in Piaget for over a third of this century, an interest which is deeper and more extensive than that they have taken in any other Western psychologist.

The methodology and conceptions in Piaget's work have received positive evaluations from the Soviets. Negative comments are directed primarily at the lack of an adequate philosophical base to his theory particularly in the relation of his concept to objective reality and at the absence of the social-historical dimension in his research. Even these shortcomings are not serious for much of Piaget's conceptualization can be assimilated readily into the mainstream of Soviet psychological thinking.

REFERENCES

[1] V. N. Sadovsky and G. A. Yudin, Jean Piaget—A psychologist, a logician, a philosopher, *Voprosy Psikhologii,* 1966, No. 4, pp. 106-120.

[2] L. S. Vygotsky, *Thought and Language,* (Cambridge: M.I.T. Press, 1962), p. 9.

[3] P. I. Galperin, A method of 'sections' and a method of the formation of mental actions by stages in the investigation of children's thinking. *Voprosy Psikhologii,* No. 4, 1966, pp. 128-135.

[4] J. Piaget, Basic problems of genetic epistemology, *Voprosy Psikhologii,* 1956, No. 3, pp. 30-47.

L. I. Antsiferova, Neobehaviouristic theory and Jean Piaget's Operator Conception, *Voprosy Psikhologii,* 1965, No. 2, p. 165-172.

[6] A. G. Komm, The problem of the psychology of intelligence in the works of Jean Piaget, *Voprosy Psikhologii,* 1957, No. 1, pp. 157-164.

[7] V. A. Lektorsky and V. N. Sadovsky, Basic ideas of J. Piaget's "Genetic Epistemology", *Voprosy Psikhologii,* 1961, No. 4, pp. 167-178.

[8] L. F. Obukhova, An experimental analysis of some phenomena of J. Piaget, *Voprosy Psikhologii,* 1966, No. 4, pp. 136-142.

[9] *Loc. cit.*

[10] *Loc. cit.*

[11] A. V. Zaporozhetz and E. N. Sokolov, The 14th International Congress of Psychology, *Voprosy Psikhologii,* 1955, No. 1, pp. 116-123.

[12] A. N. Leontiev, and A. R. Luria, The 15th International Congress of Psychology, *Voprosy Psikhologii,* 1957, No. 6, pp. 146-158.

[13] B. F. Lomov, The 16th International Congress of Psychology, *Voprosy Psikhologii,* 1961, No. 1, pp. 171-180.

[14] *Loc. cit.*

[15] J. Piaget, "Psychology, Interdiscipilinary Relations and the System of Sciences", Evening lecture at the 18th International Congress of Psychology, (Moscow: Moscow State University Publishing House, 1966).

[16] D. El'konin, "Symbolic and its function in the play of the child," *Doshkol'noe vospitanie,* 1966, No. 3, Translation in *Soviet Education,* Vol. 8, No. 7, pp 35-41.

[17] G. A. Kohnstamm, "Teaching Piagetian thought operations to preoperational children," *Sovetskaya Pedagogika,* 1967, No. 1, pp. 33-35.

[18] F. Gonobolin, "Training and Development," *Uchitel'sakaya* Gazeta, September 6, 1966, p. 3.

[19] *Op. cit.*, pp. 19-20.

[20] *Ibid.*, p. 22.

[21] J. Piaget, *Comments on Vygotsky's critical remarks,* (Cambridge, M.I.T. Press, 1962), p. 1.

[22] *Loc cit.*

[23] *Op. cit.*, p. 165.

[24] *Loc. cit.*

[25] *Loc. cit.*,

[26] *Loc. cit.*

[27] *Loc. cit.*

[28] O. K. Tikhomirov, J. Piaget, *In Pedagogicheskaya Entsiklopedia,* 1966.

[29] Henry A. Murray, "Historical Trends in Personality Research," Chapter I in H.P. David, and J. C. Brengelmann, *Perspectives in Personality Research,* (New York: Springer, 1960), p. 25.

A CRITICAL NOTICE

EDUCATION AS A DISCIPLINE

By: Marc Belth (Boston: Allyn and Bacon, Inc., 1965).

This paper presents a critical notice of Marc Belth's book, *Education as a Discipline.* The subject is not new but it is complex and it is controversial. The thesis of his book, is unconventional in its approach, and rather vague in its basic terms. For Belth "the study of education is the study of the way in which models for inquiry are constructed, altered and reconstructed."[1] It is upon the creation and use of models that reasoning and thinking depends and upon which his case for education as a discipline hinges. Yet even if his thesis fails it is possible and probable that he will have contributed something to aid the understanding of how the thinking process develops or how it can be enlarged.

Before one can criticize effectively one must understand the subject under discussion. The difficulty lies in the fact that each person approaches any subject with his own set of preconceptions based upon his own frames of reference. To read Belth and agree wholeheartedly with him would be to discard nearly all the prior knowledge one has gained. This approach is unproductive for critical purposes and in itself is almost, if not entirely, impossible. But to be fair we must examine Belth for what he in fact says about education as a discipline; not for what we would like him to say. The second is as formidable a task as the first and borders on the impossible because one is never really sure he has pinned Belth down to exactly what he does mean.

Therefore, Belth's case for education as a discipline along with what he hopes to accomplish by such a feat will be discussed. His concept of models, since his thesis hinges on the concept of models, will also be examined. In addition an attempt will be made to explore and discuss the relationship models have to thinking and to explore the relationship between thinking and ideas. This last has to do with inference, inference making, analogy, description and others. It is accepted that this treatment will provide depth in only a few aspects. Further, a critical analysis embodied in the paper is presented in so far as the work is understood and interpreted "correctly". The aim is to provide an intelligible and cohesive piece of work.

Belth places analysis of theory of scientific method of the modes of reasoning, the exposing of falacious educational cliches, the elevation of education to a high and important position, and the objectives to be attained by establishing education as a discipline, at the very heart of his analysis.[2] His approach is unconventional in as much as he deliberately questions premises which others accept as traditionally axiomatic.

Premises which Belth questions have grown out of the view that education has no real theory of its own. Some of these are clichés such as: "everyone teaches"; "all institutions educate"; "all experience educates"; and that the basis of "teaching is knowing". His writings are sufficiently clear on these to accept them at least partially. He questions the orthodox view, "that education is best understood as the total process of development of the total powers of human beings".[3] Belth challenges the idea that the intellect cannot be separated from the emotions in theory. He does not question the fact that people respond directly to the world as well as responding by means of thinking or rational processes. But he separates these responses into perceptual, and conceptual or cognitive operations, at least in theory. Studies in psychology tend to bear him out on this point. His intended separation in theory attempts examination, explanation, and organization of what otherwise remains unexplained and unorganized.[4]

Belth has rejected the traditional definition of education to propound his own view of eduation as a discipline. His efforts seem partially justified because he wishes to identify the truly important and unique features of education. Belth clearly draws a distinction between the study of education as a discipline and what actually goes on in the schools. Moreover his belief that education is concerned wih more than simple transmission of knowledge, the culture and its accompanying moral objectives. Indeed, education must be concerned with more than these if it is to become a discipline. He is not saying that education is a discipline but believes that the enlargement of thinking processes is what education should be concerned with. He is intent on exploring the theory whereby education may become a discipline with its own unique field of knowledge and its own unique method of handling that knowledge.

From this point of view his work is significant. The conventional approaches, though useful as philosophical exercises, do not seem to accomplish what Belth has set out to do. Professor Kneller gives a good description of the hopelessness of the present situation with its conventional approach when he writes:

> . . . A discipline of education will be established when reasonable agreement is reached among reasonable men regarding the fundamental unity of all purposes of education might serve and all the functions and processes belonging thereto.[5]

Conventional thinking like this tends to confuse the issue of what education should be concerned with and tends to maintain the idea that education is an all or nothing proposition.

Similarly, the conception of education as an applied discipline places the educator in an unfortunate position. He is expected to become proficient in a cluster of related disciplines at a time when knowledge about

the world is accelerating at a rate which makes this impossible. It creates the absurd situation where the educator is labelled as anti-intellectual because of insufficient depth and background in the disciplines he studies and teaches.

Belth is intent on setting education apart as a discipline. He holds that thinking of education as an applied discipline confuses "the application of principles as a discipline with the application of principles to a discipline".[6] Even more crucial to Belth's approach, however, is his reasoning that education cannot be autonomous if it borrows theories from other disciplines. He says:

> Between theories of education and theories of other areas of inquiry there are, strictly and logically speaking no direct transactions either supportive or conflicting. Each is a 'world' unto itself.[7]

What he seems to be getting at is that education as a discipline deals with the relationship between concepts and the ability of these concepts to enlarge the powers of thinking in the learner. It is concerned with methods of creating new ways of looking at things. The intent is to bring about increased inquiry and further the inquiry into knowledge itself. Education would not necessarily be concerned with the direct application of concepts in actual experience of other disciplines but rather teach how these concepts are interrelated and used in thinking by the disciplines in question. In this regard the study of education is concerned with making newer modes of description, exploration, explanation, reasoning, and invention possible.[8]

> The objectives of the study of education would be to improve methods of inquiry and creativity by which science, mathematics and philosophy perform their functions. . . .[9]

If there is anything truly distinctive about education, an inquiry into the process whereby man uses known concepts and alters them as he observes what they will produce seems a fruitful approach.[10] Similarly the procedure of education could conceivably be improved by placing greater emphasis on developing the process of accepting and altering concepts. Much improvement could be made in developing new modes of thinking rather than simply transmitting knowledge, the culture and its accompanying morals. The educator could then concentrate on developing the ability to increase the powers of thinking in his students.

This seems relevant when analyzed in conjunction with the demands being made on the school by industry, technology and a changing society. Repeatedly they ask for broadly educated individuals who can express themselves and have the ability to "think". Some employers stress the fact that they are more interested in what the person is, and what his potentials of becoming are than they are in his education alone. If the educator in the school accepts society's demands and takes on the responsibilities of transmitting cultural morals, this should be in addition,

not instead of equipping students to relate themselves and what they have learned to new and different situations.

Belth's concern with what he calls the "inversion of philosophy prescribing educational practices",[11] seems justified. This widely accepted "inversion" has hindered development of education as a discipline. Our interpretation of reality is determined by the way in which we view our problems. Our philosophical system does tend to dictate how we solve them. Inquiry into the act of educating should expose and explore philosophy, if meaning and thinking are important. In this way the basis for postulates, and theorizing and creative inventiveness can be strengthened.

The examination of education from a new direction is welcomed. Stripping the moralistic aspect of education away eliminates many problems. Belth is intent on exploring the area of thinking. He wishes to establish a unique body of knowledge in the field of education and proposes that the uniqueness of this body of knowledge can only be explored by certain methods which he calls "models" of studying that body of knowledge.

Belth wishes to produce understanding. He takes a step beyond looking at education from within. His emphasis is on inquiry into the modes of thinking which exist in education. He believes that it is not the content but the way education is conceptualized that is important. But in exploring parameters and setting boundaries one usually thinks about factual data or proofs. Belth is certainly not concerned with providing factual data or proofs, rather, he is concerned with developing theory and exploring that which has not been thought about before. But theory without a suitable factual base must be considered as conjectural hypotheses.

Central to Marc Belth's thesis of a discipline of education as the study of the way in which models for inquiry are constructed, used, altered and reconstructed is his concept of "models". Indeed it is safe to say that his case for education as a discipline depends on the acceptance of his description of thinking as the use of models.

He does not use the term models as a synonym for "structure, category, types, gestalt or method," but any one of these may be "cast into a model".[12] Models are constructions, or inventions which serve to measure, guide, explain and interpret the features and meaning of the activities clustered in specific disciplines.[13]

> Models can be objects; they can be masks, or abstractions like line drawings. Models can be of single events or of relationships of whole universes. They can refer to objects in time and place; they can refer to laws which describe the sequence and order of events; they can be purely theoretical in their references, offering a model of concepts which could never be true or false. Sometimes an entire philosophical system functions as a model.[14]

Belth uses models as windows through which the world is viewed. Indeed they seem closer to conceptual systems than models, and he alludes to this himself.[15] The function of models is to facilitate examination of events or concepts which would otherwise be unexplained.

> . . . They make explanations possible, or they offer explanations, and thus they are the basis for interpretation. They can even, in a particular situation, imply action to be taken. They contain within themselves rules not only for their application in general but for their applicability to an individual event or system under examination. These rules usually take the form of explicit or implicit statements of relevant connections among the parts of the model, and characteristics which the domain to be examined should have if it is to be understood within the model employed.[16]

Belth's use of the term 'models' is broadly and vaguely defined. He uses the term very early without setting its limits by definition, nor does one receive a clear cut definition of what models are. Indeed they can be almost anything. It is entirely likely that if a precise definition of models were set down Belth's case for education as a discipline would dissolve and certainly the need for this book would have been reduced. He has made the term models so vague that it is difficult to say they play no part in thinking, nor can one definitely say that that is how all thinking takes place. Belth's education as a discipline seems built on a precarious foundation.

Brauner has picked up this criticism of vagueness and also concludes that models exist everywhere. He tries to sort out and classify models as Belth uses them thus developing a spatial dimension to model theory.[17] This writer however, tends to think that Brauner does this with a tongue in cheek approach.

Perhaps Belth's use of models and his intentional reluctance to give a fixed definition does have merit, however. Consider model as similar to a quality like the colour red. The colour red cannot be defined by itself. It can be designated as to a position within a spectrum of colours, or talked about in relation to other colours. It can be referred to as this colour is more, or less red than that colour. But one cannot grasp the concept of red without having experienced the colour red, or having it pointed out by ostensive definition. Nor can one conceive the colour red without it being present. Red then appears to be inseparable from its referential context and cannot be defined except in relation to something else.

Perhaps colour and model as Belth chooses to think of them are similar. Surely models cannot be defined by themselves, rather, they must be pointed to as this model or that model in some purely referential situation. Belth stresses that they should not be separated from the context of the situation. But if this is true it is unclear to this writer how a purely new model can be invented. It is accepted that the mind can restructure a model with which it is familiar, as in insight, or in-

ference making, but in pure creativity and inventiveness a theory dependent on description and analogy seems to place severe restrictions on entirely new and divergent thinking. It tends to build from what one knows to what one does not know but tries to explain in terms one already understands. Perhaps this is how thinking really takes place. There is some evidence to support this view, but does it give a satisfactory answer to purely deductive thinking? For example, the theory and laws of gravity. Belth has tried to account for this by introducing hypothesis formulation, but this writer is not convinced that this is sufficient, although he acknowledges that postulate formation and theorizing are part of the thinking process.

Further it is acknowldged that models are not intended as proofs nor absolutes. They are available "as instruments of interpretation and explanation."[18] A distinctive and unique body of knowledge for education as a discipline when based on this concept is freed of much controversy. For example, the basis of controversy over what education really is stems from the inability to accept a compromise window through which to view and interpret the world and all that it contains. Education as morality has had too many sources to make a compromise possible.

One source of morality which seems fundamental to the educative process is that of integrity in matters of conducting inquiry, even inquiry into itself. This seems lacking at the present time. Nor is this problem eliminated by freeing the teacher to teach what he considers to be the truth. By accepting a compromising agreement on a particular model of the universe one is simply letting a particular philosophical system dictate how a problem is viewed and solved.[19] In this regard Belth's idea of resolving the conflict seems a step forward. The problem could be resolved in the discussion and resolution of the "models of thinking" employed in thinking. Discussion could then proceed to test conclusions derived from the models themselves, and a form of empirical data might develop. The problem of propounding one moral view against another dissolves and becomes a question of what is the best way to foster the thinking abilities of the learner in such a way that inquiry and new ways of thinking about things can develop.[20] The question which Belth directs at us is "how shall we treat the ideas and the data which the ideas make available to us".[21] It is relevant to education as a discipline. Further, what relationship exists between data and ideas as opposed to the relationships existing between data and the functions of ideas as observed in those actively engaged in the doing of a discipline.

When education is conceived, in a generic sense, as the study of models, model making and model using the models seem to become the general statements of methodology employed in the related disciplines

being studies. In the strictest sense it does not seem necessary then to be a scientist in order to discuss or teach the methods used in doing scientific research. For methods are matters determining the proper relationship between means and ends, and a way of determining the importance of one to the other. Models on the other hand, are not matters of means or ends but are instead the sources from which ends are deduced.[23] Conceived from this point of view education could reach beyond other disciplines.

The end result of "nurturing the powers of thinking" about things and the ways they are related is to gain new insight into the ways things might be meaningfully related. This writer does not believe that Belth intended this to be a fixed process nor did he intend that the models should be treated as proofs.

When one accepts the idea of education as the gaining of insight into the inter-relatedness of things it seems reasonable that inference making should follow. Necessarily the educator becomes concerned with how to teach students to use experiences of today, and yesterday in such ways as to anticipate events in the future. Similarly present events should be manipulated to bring about desired changes in the future. This requires making inferences as logical conclusions derived from data or premises relevant to the particular case being considered. The power of inference making lies in the theorizing it makes possible. It must be treated as projections upon which new truth and knowledge are possible, not as proofs or truth themselves.[24]

The use of models does not seem to give a satisfactory explanation of pure inventiveness where something is created that has never existed before. But the use of models does seem to play a role in the thinking process of insight where what one has known or learned before is suddenly restructured into a new pattern. One then sees a new relationship between the things he took for granted before.

> Even the most energetic and organized mind, in order to reorganize or extend human insight in any valuable way, must have attained more than an ordinary mastery of the field in which he is to act, a strong sense of what needs to be done, and skill in the appropriate means of expression . . . .The same is true of any creative worker.[25]

To be creative, an artist, or scientist does not always invent something entirely new. His creativity often depends on him rearranging and treating old materials in new and novel ways. This can be true of skills and concepts as well. This is not to say that the artist and scientist always use the same type of thinking, but tends to give credit to a theoretical model which enables us to identify characteristics of the so-called scientific method. It does not give a complete description of the thinking process but tends to explain what we could otherwise not explain.

In conclusion, Belth's thesis of education as a discipline based upon the study of models and how models of inquiry are constructed, used, altered and reconstructed has been studied. In addition an attempt has been made to explore and critically discuss the relationship between thinking and models, and between thinking and ideas. Belth has attempted to establish a relationship between thinking and ideas and has postulated the idea of models. But this concept of models is vague. They seem to resemble intervening variables and you can never be certain whether they exist or not. Perhaps part of the difficulty with Belth's theory and concept of models is because he seems to be expressing ideas relevant to cognitive theory in a more sophisticated manner than psychologists have done up to this time.

Although Belth maintains that analogy is only one type of model it seems that the concept of model is more closely tied to analogy than anything else because of its illustrative and descriptive function. It also seems too restrictive to fully explain truly inventive thinking since it acknowledges dependence on a preconceived conceptual system even when hypothesis are formulated. This writer therefore cannot totally accept Belth's thesis of education as a discipline because of its precarious dependence on models. However, if one is concerned about minimizing value judgements in educational theory Belth's work should lay the ground work for further analysis of what education and thinking should really be concerned with. Indeed Belth's unconventional approach enables one to question educational premises too long protected by wide traditional acceptance.

KEITH H. FAWCETT
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REFERENCES

[1] Marc Belth, *Education as a Discipline,* (Boston: Allyn and Bacon, Inc., 1965), p. 103.

[2] March Belth, "Reply to George F. Kneller", *Studies in Philosophy and Education,* Vol. IV. No. 1, (Spring, 1965), p. 150.

[3] *Ibid.,* p. 148.

[4] *Ibid.,* p. 149.

[5] G. F. Kneller, "Education as a Discipline by Marc Belth", *Studies in Philosophy and Education,* Vol. IV, No. 1, (Spring, 1965), p. 146.

[6] Belth, *Education as a Discipline, op cit.,* p. 4.

[7] J. M. Rich, "Book Review of Marc Belth's Education as a Discipline", *Educational Theory,* 1965, p. 190.

[8] Belth, *op. cit.,* pp. 7-10.

[9] *Ibid.,* p. 11.

[10] *Ibid.,* p. 85.

[11] *Ibid.,* p. 190.

[12]Marc Belth, "The Study of Education as the Study of Models," *Alberta Journal of Educational Research, Vol. XII,* No. 3, September, 1966, pp. 207-209.

[13] Belth, *Education as a Discipline,* pp. 9-10, p. 61.

[14] *Ibid.,* p. 91.

[15] *Ibid.,* p. 61.

[16] *Ibid.,* p. 91.

[17] C. J. Brauner, "Models, Models Everywhere," *Alberta Journal of Educational Research,* Vol. XII, No. 3, September, 1966, pp. 239-246.

[18] Belth ,"Reply to George F. Kneller", *op. cit.,* p. 152.

[19] Belth, *Education as a Discipline,* p. 85-86.

[20] *Ibid.*

[21] Belth, "Reply to George F. Kneller", *op cit.,* pp. 149-150.

[22] Belth, *Education as a Discipline, op. cit.,* pp 164-169.

[23] *Ibid.,* p. 207.

[24] *Ibid.,* pp. 92-101.

[25] *Ibid.,* p. 135.

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Diack, Hunter, *Language for Teaching,* (New York: Philosophical Library, 1967).

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Gourdie, Tom, *A Guide to Better Handwriting,* (Don Mills, Ontario: General Publishing Co., 1967).

Howard, Charles F. and Enoch Dumas, *Teaching Contemporary Mathematics In the Elementary School,* (Third Edition), (New York: Harper & Row Publishers, 1966).

Kaplan, Louis, *Foundations of Human Behaviour,* (New York: Harper & Row).

LaMancusa, Katherine, C., *We Do Not Throw Rocks At The Teachers,* (Scranton, Pennsylvania: International Textbook Co., 1966).

McQueen, H. C., W. B. Harris, K. W. R. Glasgow, G. H. Boynes, K. H. O'Halloran and N. S. Woods, *The Background of Guidance,* (New Zealand: Whitcombe and Tombs Ltd.).

Nisbet, John D. and Noel J. Entwistle, *Age of Transfer to Secondary Education,* (London: University of London Press Ltd.).

Saxe, Richard W., *Schools Don't Change,* (New York: Philosophical Library Inc., 1967).

Segal, S. S., *No Child is Ineducable,* (Oxford, England: Pergamon Press Ltd., First Edition, 1967).

Wright, Herbert F., *Recording and Analyzing Child Behaviour,* (New York: Harper & Row Publishers, 1967).

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